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ABSTRACT

Investigated was whether the opportunity to participate in discovery learning by means of an archaeological "dig" significantly enhances the development in sixth grade pupils of concepts and principles of archaeology and anthropology as compared with using the same data with conventional instructional procedures in a standard classroom situation. The total sixth grade population at Inland Valley Elementary School was separated on the basis of sex, and was assigned at random into two classes (one experimental and one control) of 29 pupils per class. The same teacher taught both groups. An investigator-prepared instrument was used on a pre- and posttest basis. It was concluded that: (1) the child at the "dig" (experimental group) was more of an organizer of information, more active in the task of learning, and apparently more highly motivated than those in the control group; and (2) the discovery learning activity itself produced significant differences in favor of children in the experimental group on the prepared tests which measured anthropological understandings. Also provided are: (1) a description of the program, (2) an extensive literature review, and (3) a description and subtest break-down of the testing instrument used in the study. (DS)

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INLAND VALLEY ELEMENTARY SCHOOL ARCHAEOLOGY PROJECT: AN EXPERIMENTAL COMPARISON OF TWO TEACHING APPROACHES

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DONALD WILLIAM HARDY

December 1967

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1 A

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS ii

LIST OF CHARTS v

Chapter
I. INTRODUCTION 1

Nature of the Disciplines 3
Realms of Meaning 7
Problem 10

II. REVIEW OF THE LITERATURE 12

Anthropology 12
Geography 19
Psychology 22
Discovery Learning as an Educational Approach 28
Presentational vs. Discovery Issue . . . 30
Related Projects 32
Anthropology Curriculum Project 32
Anthropology Curriculum Study Project . . 35
Science Curriculum Improvement Study . . 40
The Elkhart Project 42

III. PROCEDURES 46

Purpose 46
Description of Activities 46
Sample 48
The Teacher 50
Instrumentation 51
The Prepared Test 51
Development of the Prepared Test 53
Scoring the Prepared Test 58
Independent Scoring 59
Procedures of Experiment 62
Testing Schedule 62
Instructional Units 63
Definition of Discovery 68
Discovery (Operational) 68
Presentational (Operational) 70

Chapter Page

IV. ANALYSIS OF DATA 72

I.Q. Scores 73
Achievement Test Scores 76
Comparison of Social Studies and the Prepared Test Scores 78
Prepared Test Scores 78
Pretest 80
Posttest 80

V. DISCUSSION OF RESULTS 83

Discussion of Prepared Test Items 83
Social Studies and the Prepared Test 97
The Posttest 97
Conclusions Upheld 101
Implications of Findings 102
Limitations of Study 105
The Sample 105
The Teacher of Experimental and Control Groups 105
The Pupils 105
Testing 106
Suggestions for Further Study 106
Conclusions 108

BIBLIOGRAPHY 111

APPENDIX
Attachment #1. Anthropology Prepared Test 117
Attachment #2. Bushman Site Map 123
Attachment #3. Prepared Test Scoring Standards . 124

LIST OF CHARTS

Chart Page

1. Correlation between Scorers on Pretest Total 60
2. Correlation between Scorers on Posttest Total 61
3. A Comparison of Experimental and Control Group Mean Scores on Lorge-Thorndike I.Q. Test . 73
4. Correlation between Social Studies and the Pretest 74
5. Correlation between Social Studies and the Posttest 75
6. Comparison of Experimental and Control Group Mean Scores on Stanford Achievement Test . 77
7. Outline of Prepared Anthropology Test 79
8. Comparison of Experimental and Control Group Mean Scores on the Pretest 81
9. Comparison of Experimental and Control Group Mean Scores on the Posttest 82

CHAPTER I

INTRODUCTION

"I believe that the school must represent present life--life as real and vital to the child as that which he carries on in the home, in the neighborhood, or on the playground." (Dewey, 1897, p. 79) These words from John Dewey's pedagogic creed exemplify one important facet of a conflict which has stirred American education for most of the present century. His statement was in sharp contrast to the existing philosophy and practices of American education at the time it was made. The educator was striving in part for recognition of the child as an active participant in the learning process. The idea was not a new one since it had been expressed periodically throughout the recorded world history of education. Dewey's philosophy was destined to have profound and far-reaching effects on twentieth-century American education. It is apparent that there will never be a return to the curriculum as it existed a half-century ago when subject matter was taught with little or no regard for or understanding of human development, but with strong emphasis on developing "mental discipline."

One older theory holds that transfer of learning results automatically from the study of certain subjects, such as mathematics, Latin, and philosophy, that it occurs by training the mind, and that certain subjects discipline the mind better than others. Locke, for example, advocated mathematics as a discipline of the mind, because it would build the habit of reasoning closely. More recent philosophical and psychological theories, however, are bringing about a shift in emphasis in curriculum development, and it is the purpose of the following paragraphs to point up the direction and the nature of that change in order to provide a frame of reference for this study.

Recently, when engaged in curriculum construction, educators have been encouraged to give attention to the academic disciplines as fields of inquiry. Considerable research has been carried out toward the purpose of describing and defining the nature of the disciplines and pointing up their inherent value as sources of curriculum content. (Phenix, 1964) Increasing efforts have been made to involve the scholar in curriculum organization primarily for the purpose of identifying those fundamental or key concepts and methods of inquiry which constitute the framework of his discipline. It is becoming increasingly apparent that central aspects of the disciplines can be taught to children in a manner that is consistent with the ways in which children learn, and further insight is being gained into the ways in which children develop and learn. The work of Piaget, Vygotsky (1965), and others seems to provide a basis for an understanding of the stages of cognitive development which is indispensable to meaningful curriculum organization.

Recent projects in the physical sciences (Karplus, 1964) provide evidence, or at least situations in which we might test the hypothesis, that learning takes place on a meaningful basis when children are encouraged to function, on their level of cognitive functioning, in ways consistent with those of scientists. In other words, the children are encouraged to develop what Karplus calls "scientific literacy." This opportunity exists in the social studies as well as in the physical and biological sciences. The kinds of experiences which are usually reserved for the university student can, it is assumed, be put to significant use in the elementary grades.

The present study will attempt to test these new assumptions by studying children who have been exposed to a social studies program based on the discipline of anthropology.

Nature of the Disciplines

Prerequisite to a discussion of the discipline of anthropology is a consideration of how to describe the nature of any discipline. Phenix (1962) provides a definition as follows:

> A discipline is knowledge the special property of which is its appropriateness for teaching and its availability for learning. A discipline is knowledge organized for learning. Basic to my theme is this affirmation: the distinguishing mark of any discipline is that the knowledge which comprises it is instructive--that it is particularly suited for teaching and learning. (p. 58)

He suggests three characteristics of knowledge which make it disciplined and instructive.

1. Analytic simplification, or the degree to which a discipline lends itself to the meaningful analysis or sorting out of central concepts. He points up that, "The test of a good discipline is whether or not it simplifies understanding. When a field of study only adds new burdens and multiplies complexities, it is not properly called a discipline." (p. 61)

2. Synthetic coordination, or the extent to which it reveals significant patterns and relationships, and the coordination of elements into significant coherent structures. In other words, the component elements of a discipline lend themselves to the construction of a meaningful relationship or framework.

> The notion of parts within an ordered whole involves both the differentiation which is presupposed by the idea of the parts and the unity which is implied by the idea of a whole. A discipline is a synthetic structure of concepts made possible by the discrimination of similarities through analysis. (p. 62)

3. Dynamism.

> A discipline is a living body of knowledge, containing within itself a principle of growth. Its concepts do not merely simplify and coordinate;

> they also invite further analysis and synthesis. A discipline contains a lure to discovery. (p. 62)

Foshay (1962, p. 68) defines a discipline as a "way of knowing" and attributes three main elements to any discipline.

1. It has a domain--the phenomena, or the aspects of life, for which it takes responsibility.

2. It has methods or rules according to which the scholar in the discipline seeks and handles the data in the domain.

3. Any discipline has a history or a tradition, which enters into the decision on both the domain and the rules according to which it proceeds as a field of learning.

He discusses the use of the disciplines as bases for school curriculum.

> The idea that we wish students in the lower schools--and thus the whole mass of our population to know how a historian thinks about history, how a scientist thinks about science . . . and so on--the idea is . . . a truly radical curriculum proposal. It promises that the means for creativity are given to the students from the very beginning. It offers a way around the subject-centeredness against which we rebelled. It offers, too, a way to end the dichotomy between a problem-centered approach and a subject-centered. (p. 70)

One approach to the question of incorporating the disciplines into the curriculum is presented by Phenix. Some of his ideas which relate most directly to this study follow.

Phenix holds that human life itself is search for meaning and that general education is the process of engendering essential meanings. (1962, p. 5) He identifies those forces he sees as threats to meaning, as follows.

1. Destructive skepticism. Spirit of criticism and skepticism is part of the scientific heritage, but it has tended to bring the validity of all meanings into question.

2. Fragmentation. The depersonalization of life caused by the extreme specialization of a complex, interdependent society.

3. Overabundance. The sheer mass of cultural products, especially knowledge, which modern man is required to assimilate.

4. Transience. The rapid rate of change in the conditions of life, resulting in a pervasive feeling of impermanence and insecurity.

Phenix goes on to state that the curriculum must be planned to overcome these destructive forces.

He asserts that for a human to achieve his full potential he should be exposed in depth to the full range of knowledge which Phenix has divided into six "realms of meaning." (1964, p. 28) Each realm has characteristic structure or framework and unique methods of inquiry. (*Ibid*.)

Realms of Meaning

Realms of Meaning	Disciplines Encompassed
Symbolics	Ordinary language, mathematics, nondiscursive symbolic forms
Empirics	Physical sciences, life sciences, psychology, social sciences
Esthetics	Music, visual arts, arts of movement, literature
Synnoetics	Philosophy, psychology, literature, religion, in their existential aspects
Ethics	The varied special areas of moral and ethical concern
Synoptics	History, religion, philosophy

Phenix suggests the following guides for the selection of curriculum content.

> 1. Content of instruction should be drawn entirely from the fields of disciplined inquiry, i.e., the six realms.
>
> 2. The content must be representative of the field as a whole. (Representative ideas simplify the learner's task.)
>
> 3. Content must reflect the methods of inquiry of the discipline.
>
> 4. Content should appeal to the imagination.
>
> 5. Meaningful education is carried out by teaching the structure of a discipline as opposed to teaching a collection of unrelated facts as sometimes occurs in more standard approaches. A child should have a valid set of criteria upon which to base his judgments. (1962, p. 28)

Bruner (1962) emphasizes the need for scholars to become involved in the school curriculum--primarily for the purpose of defining the structure of the disciplines. He states that teaching the structure of the disciplines will promote transfer, make subjects more comprehensible, make details more easily recalled, and narrow the gap between advanced and elementary knowledge. (pp. 23-26) Foshay (1962) points up an important difference between the disciplines as discussed here and the more standard approach to subject matter. "The difficulty with the old subject matter approach was that the subjects were not conceived as having intellectual merit, but only as preparation for some later period in life when intellectuality was to be pursued in its own terms." (p. 71)

The old subject matter approaches emphasized teaching the disciplines for development of the mind. Taba (1962) comments:

> The central idea of this theory is that the mind inherently contains all the attributes, or faculties, and that the task of education is to bring them forth by the exercise of acquiring knowledge. The harder this knowledge is to acquire, the better its acquisition trains the mind. For this reason special merit is found in such "hard" subjects as mathematics and Latin. (p. 79)

Current trends in curriculum development, while emphasizing the disciplines, are in opposition to the ideas stated above. In several recent projects, scholars and educators have striven to describe and define the structure, or key elements, of the disciplines for curriculum content because they (the structures) seem to provide a sound basis for real understanding in the disciplines, as opposed to learning a collection of unrelated specific facts within a subject matter field.

Current theories regard the intellect as developmental in nature, as opposed to being fixed or predetermined. It is further held that the child can function in the manner of an expert in the disciplines. Bruner (1962) states:

> Any subject can be taught to any child at any age in an intellectually honest form--assuming of course, that the subject or discipline to be taught to a child must be adapted to his level of cognitive development. (p. 22)

Important differences are apparent in the ways in which the child and the scholar view the world. The scholar is almost certainly operating on a cognitive developmental level which involves the complex manipulation of abstractions. The child may still, however, need concrete aids to carry out cognitive operations. The wealth of intellectual background and experience possessed by the scholar also draws a sharp line of distinction between him and the child. To illustrate, a child confronted with a quartz crystal may have a framework of concepts and principles regarding size, shape, color, texture, and transparency, into which he can incorporate quartz. The scholar, on the other hand, may possess hundreds of concepts and principles into which quartz can be incorporated.

In view of these recently emphasized theories which bear so directly on education, it is evident that a close look should be given to the present condition of curriculum in the schools. Bruner (1962) sees curriculum improvement as a vital necessity in most areas of the curriculum. He states his position as follows:

> It should be utterly clear that the humanities, the social studies, and the sciences are all equally in need of imaginative effort if they are to make their proper contribution to the education of coming generations. (p. 10)

Problem

A major purpose of this project was to apply some of the ideas of Phenix, Bruner, and others (as discussed earlier) in an elementary school setting in the discipline of anthropology.

A unique opportunity to do this existed at the Inland Valley Elementary School in Orinda, California. A previously unrecorded, unexplored, Indian archaeological site was available for excavation. This excavation was carried out by sixth grade children in order to determine whether or not this experience (discovery learning with primary source materials in archaeology--in the field) is more educationally desirable than using these same materials already collected by others and brought into the classroom.

Ausubel and others are of the opinion that meaningful learning can and does take place in the standard classroom setting by means of instruction that is principally verbal in nature, while Bruner and others support the notion that "discovery" learning is vital and necessary for meaningful learning. The issue of presentational versus discovery learning brings the problem into focus. The difference to be tested was between carrying out the actual "dig" and having the same information taught in a classroom situation. Children in the experimental group of this study performed as archaeologists in the field and their results were compared with those of a similar group of children who had not done field work. (See Chapter III, Procedures.)

The major theoretical focus of this project was upon elements of the structure of anthropology and the methods of inquiry germane to that discipline, and aspects of the psychology of learning. An attempt was made to provide a synthesis of psychological and educational theory insofar as both relate to this project. In other words, an attempt was made to justify the undertaking of this project not only in terms of providing instruction in the discipline of anthropology to elementary school children, but also in terms of an educationally and psychologically sound rationale. The central issue, of course, rested with the "dig" itself. We are inclined to assume the superiority of this kind of direct, "inductive" type of learning experience as opposed to a more standard type of classroom teaching. But is this really the case? That is the question to which the Inland Valley Project (IVP) addressed itself.

CHAPTER II

REVIEW OF LITERATURE

Anthropology

Major sections of this chapter include a view of anthropology and geography insofar as those disciplines relate to the Inland Valley Elementary Archaeology Project. Some psychological aspects of learning and development are considered because the ways in which children learn are central to this study. Related projects are reviewed which give a background with which the Inland Valley Elementary Archaeology Project can be contrasted.

Guthe (1965) has provided an overview of the structure of anthropology and methods of inquiry used by anthropologists. Anthropology is defined as an understanding of the relationships between man as a biological entity and his adaptations to his environment, including other men. Thus the two major branches of anthropology include physical anthropology and cultural anthropology.

Physical anthropology treats man as a biological being with focus upon such characteristics as eye color, hair, blood, and skeletal formation. Another area of interest in physical anthropology is the recapitulation of human evolution. Buthe (1965) states:

> During the past 100 years, evidence gathered indicates that our present species (Homo Sapiens) existed over 30,000 years ago. This evidence consists of skeletal remains found situated in deposits of known geological age or in association with cultural remains for which radio carbon dates have been obtained. The value of this kind of data lies in the definition of human characteristics and the structural changes that have taken place. (p. 173)

Cultural anthropology views man's adaptation to his environment in all of its aspects. Culture is a distinctly human phenomenon. Guthe further states:

> Culture it is said, is man's way of adapting to his environment. But men at different times, in different places experience different natural environment. Thus something more is involved than a simple adaptation of the human organism to his natural environment. This extra something is culture, that is, the ideas, knowledge, belief, and systems of behavior which man has learned as a member of society. These have developed through social interaction and because of their effectiveness in dealing with the natural environment. (p. 174)

Archaeologists and ethnographers study specific cultures and their content. The archaeologist recovers evidence pertaining to the culture of former societies. The ethnographer obtains data through observing a living society.

One basic approach to an understanding of a cultural system is to describe the interrelations of traits and of traits to environmental characteristics. It is based on the assumption that each trait in a culture must be in relation to other traits in the culture for the system to exist.

Beals (1965) states:

> The routine needs of living are everywhere indissolubly bound to organized and ever-present routines of satisfaction; otherwise human societies could not exist. . . . Economic systems are a response to the imperative that tools, implements, and other material necessities be made, used, maintained, and replaced. (p. 723)

Cultural anthropology is not only concerned with describing how man has adjusted to his environment, but also with questioning why he does what he does. The wide differences among cultures indicates a wide diversity of traits among peoples. The assumption that man has many choices seems to hold true throughout all known societies; that is, that man responds to the dictates of his environment is beyond any question, but many of man's activities are also beyond the scope of environmental mandates.

In another vein, it can be asked whether human societies exhibit any regularities that permit the definition of a universal system developed by mankind. Guthe (1965) comments thus:

> It appears there are such regularities. The table of contents for most introductory texts indicate this. The presentation of data describing how people do things follows a general order. This order has resulted from the comparison of cultures. . . . Such comparisons are called cross-cultural because they examine certain elements, or clusters of elements, as they are manifested in several cultures. (p. 182)

As noted, the requirements of life are met in diverse ways by the human organism, and categories of culture exist which are common to all cultures. Herskovits

(1965) identifies five major groups of cultural phenomena which are considered universal:

1. Material--food, shelter, clothing, technology, etc.
2. Social--family, kinship, government, clubs, etc.
3. Intellectual--religion, science, etc.
4. Aesthetic--music, dance, poetry, painting.
5. Linguistic--verbal communications. (pp. 116-18)

It should be emphasized that the categories listed above indicate classification of cultures resulting from cross-cultural comparisons prepared by ethnographers. The classificatory framework appears to be complete, and with sufficient data a comprehensive picture of any culture could be devised following this guide. But sufficient data are not always available, and herein lie the difficulties encountered by the archaeologist, who reconstructs as complete and definitive a picture of a culture as possible on the basis of what remains of that culture.

In the study of former California Indian tribes, for instance, the rubbish heaps, the broken projectile points, the abandoned hearths, the burials, all comprise the tools with which the archaeologist works to reconstruct elements of living societies. The limitations imposed upon the archaeologist are apparent. His reconstruction will of necessity accentuate material classifications--food, shelter, clothing, tools. He makes assumptions regarding social, intellectual, aesthetic, and linguistic components of a culture, but by the very nature of his task the archaeologist is much less complete in terms of his analysis of the total scope of a culture than is the ethnographer. Heizer (1965) reports:

> Archaeological techniques per se can never yield all the data for a reconstruction of the past, since the non-material aspects of culture (e.g., language, religious practices, social organization, government, law, mythology, etc., etc.) leave few or no traces when the people who produced that culture are gone. Only those aspects of life which are expressed in material form can the excavator hope to recover in quantity. (p. 17)

Information on non-material aspects of life is gained through archaeology, but on a more modest basis. For example, artistic ability and practices may be inferred from pottery designs; some assessments of musical ability may be made on the basis of instruments recovered. To avoid relegating archaeological field work too emphatically to the reconstruction of the material culture, we shall quote Heizer (1965) again:

> Religion may be expressed in the form of tangible objects of ceremonial paraphernalia, like charmstones, or, directly, in the mortuary complex. The rigid conformity to extended burial by the Early Horizon population of central California . . . must have had a religious connotation. (p. 19)

Gorenstein (1965) reports:

> All archaeologists no matter where they are digging have the same aim. They are trying to reconstruct the past from what they have been lucky enough and skilled enough to find of that

> once vast body of material things that have been ravaged by time, climate and history . . . archaeologists are concerned with the whole life of a people, not only with wars and kings. They are interested in how men worked, their rights and duties in their communities, how they practiced their religion and even what they wore and how they entertained themselves. (p. 6)

Gorenstein (1965) continues:

> The archaeologist knows that as he excavates a site, he destroys it, and a great deal of effort has gone into devising systematic techniques to preserve more and more of the material in sites and reveal more exactly the position of objects and features found in the excavation. Such items as fishhooks, arrowheads, and seed baskets can reveal something about the economy of a people. (p. 7)

Gorenstein (1962) distinguishes between artifacts and features as follows: "Features are aspects of a site where formation is due to the activity of man, but differ from artifacts in that they incorporate part of the terrain in their form. Floors, postholes, pithouses, and hearths are examples of features." (p. 10)

It is the relationship of artifacts, features, and other materials within a site that provides the archaeologist with the vital information he needs to reconstruct elements of a culture. Groupings of artifacts and features provide significant clues. For example, concentrations of animal bones (a feature) show evidence of a butchering station; a rock pile may have been a workshop.

Burial practices are of special interest to the archaeologist because they not only provide information pertinent to age at death, infant mortality, and disease, but are a relatively rich source of goods used by people in their everyday lives.

Thus archaeology yields information on the total way of life of a people, but with considerable emphasis on the material aspects of a culture. This archaeological frame of reference provides considerable impact on the IVP.

The Inland Valley Elementary School Archaeology Project uses instructional units focusing on cultural invariants which have been categorized within the structure proposed by Herskovits--food, clothing, shelter, tools, religion, and trade--for the study of California Indians. The instructional units begin with Ishi to provide children with as broad a background as possible. Ethnographic records compiled by Waterman and Kroeber provide considerable background about the total way of life of Ishi and his tribe, but food, shelter, clothing, tools, religion, and trade are nonetheless central to these units. These invariants are then carried forward to the study of the Horizon periods which consist of much more meager information provided primarily by archaeologists. Finally, having been taught methods of excavation and classification used by archaeologists, in the final unit pupils attempt to reconstruct elements of an unknown culture, that of a Yokuts tribe. One group went into the field to do this; another used the excavated materials in the classroom.

The cultural invariants followed in the IVP instructional units provide a framework which may be filled in to a greater or lesser degree depending upon the availability of data. As noted above, the Ishi unit is comparatively rich in information, not only in the material categories of a culture, but in the social, intellectual, aesthetic, and linguistic as well. The Horizons unit provides much less data than the Ishi unit, and the site to be excavated gives promise of yielding information mainly regarding the material culture of the Yokuts Indians.

Geography

Considering the fact that this study draws upon the discipline of geography in some instances, an overview of points germane to the IVP study is included here.

Warman (1963) provides a description of a structure of geography in which he includes the following elements:

1. Areal Distinction, Differences, and Likenesses--People differ from place to place, and environment differs from place to place. Comparison of distinctive associations and interactions.

2. The Region and Regionalizing--How to identify regions. Techniques of regionalizing. Interlocking relationships--natural or man-made. Varieties of regions include physical, cultural, or economic.

3. Resources Culturally Defined--Man-land relationships including people as resources.

4. Man the Chooser--Man decides how to use the environment to meet his requirements.

5. Spatial Interaction--Movements of people and goods between regions. There is constant interplay and interdependence in the vegetative and animal life of the earth.

6. Perpetual Transformation--Change is continuous. Cultural and physical world are undergoing perpetual change.

Stimson (1965) comments on the nature of geography:

> Geography deals with areal arrangement. Its principal orientation is toward the earth's surface and the varying distributional patterns created by nature and man. It seeks to define the earth's physical and cultural features, to show their distribution and to present the more fundamental of their interrelationships. Because of its dual nature, geography is both a natural and a social science and, as such, helps to integrate both. . . . Cultural geographers are interested in the activities of people in relation to their spatial organization, they seek to interpret the various world, regional, and local patterns of economic, social, and political behavior. (pp. 308-10)

In considering the nature of geography as reported above, it is apparent that the lives of all men are integrally bound in extensive and intertwined relationships with geographic principles. In the Inland Valley Elementary Archaeology Project, study was made of Indians of California within their geographical context. The regions in which they lived, their decisions about and relationships with their environment and other geographical factors are vital to the comprehensive consideration of the California Indian. The bountiful nature of the geography of California undoubtedly contributed significantly to the California Indian as we know him. To cite one example, we know the California Indian as a hunter and gatherer with an abundance of game and plant food--in contrast to the Plains Indian who became a specialist in the buffalo hunt due to the abundance of that animal on the plains coupled with a lack of other natural food sources.

Stimson (1965) lists a number of generalizations from geography which seem especially pertinent to this study. A listing of those generalizations follows:

> a. The extent of man's utilization of natural resources is related to his desires and to his level of technology.
>
> b. The amount and kind of food needed for health vary with climatic conditions and man's technology.
>
> c. Factors of production, including technology, are subject to change. Therefore, geography is concerned with changing patterns of land use.
>
> d. The sequence of human activities and culture patterns is related to geographic locations and accessibility and to the particular time in which human beings live. People in different stages of civilization react differently to similar environments. (pp. 310-11)

To illustrate the connection between the above material and the IVP, pupils were guided to locate on a map the areas in California inhabited by Ishi's tribe. Such factors as availability of acorns, good hunting areas, fishing areas, and climate were discussed in relation to the seasonal migratory patterns of the Indian tribe as well as the technology of the tribe. Pupils compared and contrasted the patterns of this hunting and gathering society with other cultures. They were led to generalize that the Indians of California did, in fact, appear to be particularly well adjusted to their environment, or ecological surroundings.

The role that man's environment plays in shaping his ways of living was particularly emphasized in the project. As the pupil gained more insight into the geographical connotations of California Indian life he was better able to view the totality of that existence in its proper perspective.

Psychology

Piaget holds that development of the intellect (cognitive processes) is hierarchical in nature. Below, a brief description is given of those stages.

During the sensori motor stage, the child may be regarded as storing information in patterns of action, i.e., sensori motor schemata. These schemata increase in complexity and relatedness throughout the first eighteen months or so of life. In new situations the child (finding his original pattern inadequate) varies it or accommodates himself to the new situation--the child's action patterns are modified and assimilated into the schemata.

The preoperations stage is characterized by the child's development and use of language. He becomes more and more adept at acquiring labels for experience and forming concepts. In earlier stages the child accommodated his actions to the size and shape of objects he encountered; he now accommodates thought patterns to more and more dimensions of his experience.

The concrete operations stage of the child is exemplified by his ability to do problem solving through the use of concrete operations, i.e., operations such as addition and subtraction in mathematics and constructing logical classes. Two significant accomplishments during this period are the ability to use symbols and his ability to internalize and reverse operations. He can manipulate the world mentally, but he needs concrete aids. The child labels and classifies--he is able to maintain a large category while manipulating subcategories.

At about nine to eleven years of age the child progresses to the stage of formal operations. He is able to operate upon classes, or make hypothetical propositions. He is now at the adult level of operations: he is able to deal with objects on a meaningful level without concrete aids. Each of the above stages is necessary and prerequisite to the stage that succeeds it.

The pupils in this study are best represented by Piaget's formal operations stage, although they are not necessarily operating in the formal stage in anthropology. This particular stage of cognitive development relates directly to the rationale for the project which will be developed later.

Gagné (1966) describes eight conditions of learning which seem compatible with the cognitive developmental theories of Piaget, Bruner, and others.

1. Signal learning
2. Stimulus--Response
3. Chaining
4. Verbal associations
5. Multiple discriminations
6. Concepts
7. Principles
8. Problem solving. (p. 58)

Gagné establishes these categories as hierarchical in nature and each stage as a vital prerequisite of the succeeding stage. Thus a child in Piaget's concrete operations stage is possessed of a sufficiently advanced cognitive structure to classify objects with concrete aids, but according to Gagné the ability to classify (form class concepts) must be preceded by multiple discrimination which in turn must be preceded by verbal associations, etc. Thus we find two theories coming into focus within this project: Piaget's theory of cognitive development, and Gagné's which provides hierarchical conditions of learning.

Learning in the sense that the term is used in this study refers to changes in behavior capabilities over relatively short periods of time with respect to relatively specific forms of behavior; for example, a child learns new names for things, new motor skills, new facts. Development refers to capability changes comprised of general classes of behavior observed over longer periods of time. (Gagné, 1966, p. 1)

Piaget's theory (cognitive adaptation) assigns only a contributory importance to the factor of learning. (Flavell, 1963, p. 46) Gagné, on the other hand, holds that the development of the human intellect is based upon cumulative learning. He states that new learning depends primarily upon the combining of previously acquired and recalled learned entities, as well as upon their potentialities for transfer of learning. Complex principles are formed from combinations of simpler principles, which are formed by combining concepts, which require prior learning of discriminations, and which in turn are acquired on the basis of previously learned chains and connections. (Gagné, 1966, p. 25)

Gagné (1966) comments on the stages of learning:

> It may be said that the stage of intellectual development depends upon what the learner knows already and how much he has yet to learn in order to achieve some particular goal. Stages of development are not related to age, except in the sense that learning takes time. (p. 25)

Thus Gagné takes issue with the developmental stages of Piaget.

Gagné also refutes such classifications of collections of learner capabilities as "the conservation principle," or the "principle of reversibility" as classifications which exist in the mind of the external observer, but do not necessarily form a part of the learner. He states, "What is lacking in children who cannot match liquid volumes is not logical process such as 'conservation,' 'reversibility,' or 'seriation,' but concrete knowledge of containers, volumes, areas, lengths, widths, heights, and liquids." (Gagné, 1966, p. 19)

What seems to be more significant to this study than differences between the theories of Piaget and Gagné is the compatibility of relationships which seem evident. Piaget provides classifications of developmental stages into which the learning theories propounded by Gagné can be synthesized. Future sections of this study refer explicitly to Gagné's conditions of learning. For example, the process of learning specific anthropological concepts is described. The Piagetian developmental stages provide a frame of reference specifying those predominate modes of cognitive functions characteristic of different age levels. In other words, the conditions for learning concepts and principles are viewed in relationship to the cognitive operations of children as described by Piaget.

In the Inland Valley Elementary School Archaeology Project, elementary children who had reached the formal operations stage of mental development were taught a structure of anthropology (as previously defined), but not necessarily a formal stage of operations in anthropology. The intent was to have children function in the manner of archaeologists, on their level of operations with emphasis on "discovery" learning procedures. Selected areas of Herskovits' five major groups of cultural phenomena found in all cultures (material, social, intellectual, esthetic, and linguistic) formed the basic structure of instruction. As noted above, all units used food, shelter, clothing, tools, trade, and religion as focal points. Teaching took into account Gagné's (1966) levels of hierarchy in establishing the proper sequence for instruction. In Gagné's words:

> It is possible to "work backward" from any given objective of learning to determine what the prerequisite learnings must be; if necessary, all the way back to simple verbal associations and chains. When such an analysis is made, the result is a kind of map of what must be learned. Within this map, many alternate routes are available, some of which are quite as good as others in achieving the desired objective. But what is not possible in such a plan is to "skip over" some essential intervening capabilities. (p. 173)

For example, in order to deal with the kinds, uses, and implications of tools in California Indian culture it is necessary to appraise pupils' existing concepts of tool. The concept of tool is then generalized to include the necessary background of understanding required in order to proceed with the next highest levels (principles).

To illustrate further, shell beads in an inland site indicate evidence of bartering among tribes. Upon finding a shell bead the child proceeds on the basis of prior learning to discriminate shell beads from non-shell beads. Combining these concepts of shell beads with other concepts--locations of site, source of shells, and others--he forms principles related to bartering. If, however, the child is unable to discriminate shell beads from non-shell beads, it is necessary to "work backward" to determine what learnings must be established.

The combination of the developmental stages of Piaget together with the learning conditions of Gagné seem to provide a necessary background in both specific cases of learning and longer range stages of cognitive development. These theories provided a psychological basis for the Inland Valley Project.

Discovery Learning As An Educational Approach

It has been said that "discovery" type learning activities are necessary for education when a child is in the concrete operations stage of cognitive development during which he must use concrete aids. (Ausubel, 1963) Others hold that "discovery" type activities are necessary for meaningful learning during the formal stage as well. (Bruner, 1966) In the following paragraphs some current views of "discovery" learning are examined and some contrasts are made with presentational learning.

Among the several writers who concern themselves with "discovery" learning, Bruner (1966) appears to be one of the strongest proponents of its use. He states, "If man's intellectual excellence is the most his own among his perfections, it also is the case that the most personal of all that he knows is that which he has discovered himself." He goes on to say that "discovery, whether carried on by a schoolboy going it on his own or by a scientist cultivating the growing edge of his field, is in its essence a matter of rearranging or transforming evidence so reassembled to new insights." (p. 82)

In the IVP, "discovery" learning was not intended to imply that that which was discovered had never been discovered before, but the meaning intended was that the discovery was new to the learner himself. It is true, however, that the excavations contributed new information and data to the field of California archaeology. An operational definition of "discovery" learning is presented in a later section.

For purposes of this investigation, it seems appropriate to emphasize the difference between scientists utilizing an extensive background in anthropology to expand and enhance the discipline of anthropology and the functions of sixth grade children working in the manner of archaeologists.

A related view of "discovery" learning is presented by Schwab (1962), who distinguishes between stable inquiry (where known principles are accepted and followed) and fluid inquiry (where basic principles themselves are brought into question in the course of research). Schwab describes the kind of learning situation he believes should exist in the classroom situation:

> This art consists in knowing what questions to ask of a report of inquiry, when to ask them, and where to find the answers. This kind of skill is learned by doing, by exercise, and is taught by guiding the doing.
>
> Hence, the enquiring classroom is one in which the questions asked are not designed primarily to discover whether the student knows the answer but to exemplify to the student the sorts of questions he must ask of the materials he studies and how to find the answers. (p. 67)

Phenix (1964) distinguishes between discovery and guided rediscovery, and makes the following comments on methods of inquiry:

> It should not be concluded that the ways of inquiry used by experts in a discipline provide a pattern to be imitated by the teacher and student in general education at all levels. . . . Normally the experienced worker uses advanced methods, while elementary methods are appropriate for beginning students. . . . Nevertheless, the methods of inquiry in a discipline are still substantially relevant to the methods of teaching that discipline. For example, the essence of learning mathematics is in learning to think like a mathematician. To really learn art is to think the way an artist thinks. . . . Learning history similarly depends on thinking like a historian. . . . One clue to good teaching, then lies in a program of guided rediscovery, in which the student discovers for himself what others before him have found out. His discovery, however, differs from the original in that it is carried out under conditions graded to his level of advancement in the subject and with guidance based upon prior knowledge. (p. 336)

Presentational vs. Discovery Learning

There appear to be none who totally deny the usefulness of "discovery" learning, but there are two distinct schools of thought regarding the relative importance and instructional use of discovery methods. Ausubel (1963) makes the following statement: "The issue becomes, then, not instruction vs discovery, since both are essential, but a consideration of the relative importance to be accorded each in the educative process. (p. 143) Ausubel, however, generally holds a position regarding "discovery" learning that is in opposition to that of Bruner. Some of their respective ideas are noted in the following paragraphs.

Ausubel (1963) acknowledges the usefulness of "discovery" learning, especially when learners are in the concrete operations stage of cognitive development, and in the teaching of problem solving techniques and the appreciation of the scientific method. He states: "The crucial points at issue however, are not whether learning by "discovery" enhances learning, retention, and transferability, but whether it does so sufficiently for learners who are capable of learning principles meaningfully without it, to warrant the vastly increased expenditure of time it requires." (p. 144)

Bruner (1966) holds that: "Emphasis on discovery in learning has precisely the effect on the learner of leading him to be a constructionist, to organize what he is encountering in a manner designed to discover regularity and relatedness. . . . [D]iscovery indeed, helps the child to learn the varieties of problem solving, of transforming information for better use, helps him to learn, helps him to learn how to go about the very task of learning." (p. 87)

It was the aim of the Inland Valley Elementary School Archaeology Project to provide a situation in archaeology which would yield evidence as to the relative merits of primary source "discovery" learning over learning of a verbal type more typical of standard classroom procedures.

Related Projects

Four projects have been selected for brief description because of their comparability to the IVP.

Anthropology Curriculum Project (ACP)

At the outset of the Anthropology Curriculum Project at the University of Georgia, project members conducted an extensive examination of school textbooks and classroom units in anthropology and found that anthropology on a meaningful sequential basis was sadly lacking in the schools. "In other words, it is not just enough to teach about Indians and to learn about wigwams and tepees. Teachers are wanting to have these bits of knowledge to add up to something and convey certain concepts about mankind. Children are able to grasp more of this sort of thing than we give them credit for." (Bailey, 1964, p. 4)

"The Georgia Anthropology Curriculum Center has taken the point of view that anthropology can be presented as a distinct field with its particular factual and conceptual contributions to knowledge. Anthropology has the advantage in that it offers content and methodology which bridge the natural and social sciences and provides unifying concepts for the study of history, geography, and the behavioral sciences. Furthermore the contributions of physical and cultural anthropology to social understanding appear to be best presented in their original scientific frame of reference rather than as part of the value system of present elementary social studies. In this respect the project differs from the majority of the thirty-four social studies projects now active. Most of them are concerned with general social studies curriculum." (Bailey, 1964)

The above comment by Bailey points up what is probably the primary similarity between the Inland Valley Project and the Anthropology Curriculum Project--the presentation of anthropology as a distinct field (discipline) within its own frame of reference. To date, three units are available for general use on the elementary level from the ACP: a) The Arunta; b) The Kazak; and c) The American.

The ACP seems unique in its emphasis on a developmental program of anthropology for the elementary grades. Bailey (1964) comments: "The goal of this project is a sequence of units in anthropology that will present the basic concepts of anthropology in the elementary grades one through seven." (p. 10) Here there is a difference between ACP and the IVP. The IVP did not attempt a developmental sequence of lessons on separate grade levels, but rather, one comprehensive unit in anthropology which is taught in grade six.

Although instruction does not appear to stress "discovery" learning in the ACP, the content of the curriculum is comparable to that of the IVP. Pupils in the ACP are provided with texts which develop concepts of culture.

Cultural invariants among the Arunta, Kazak, and Americans are contrasted. The IVP seems to parallel the ACP in the sense that certain aspects of culture, such as shelter, religion, and others, are compared in varying societies. The textbook presentation of ACP is of a conventional type of classroom instructional procedure. This kind of approach compares with instruction given to the control group in the Inland Valley Elementary School Archaeology Project, although the IVP children were without texts on a one-to-one basis, and they were shown artifacts as part of their normal instruction. The IVP experimental group received instruction with strong emphasis on primary "discovery" learning activities (exploration in the field).

Thus the IVP taught a structure of anthropology similar in some respects to that of ACP in what is hypothesized to be a more effective method, that is, primary discovery. The major difference between the two projects seems to rest not in terms of ultimate goals, but rather in the teaching strategies employed to reach those goals. This similarity of objectives seems true even though the ACP provides for a long-term developmental instruction sequence covering grades one through seven and the IVP provided only one instructional unit in grade six; in other words, the discipline of anthropology was central to both projects.

Anthropology Curriculum Study Project (ACSP)

Three units are presently under development and in use on a pilot basis for secondary schools. One unit will be described here in some detail as it relates directly to the IVP study even though prepared for high school children.

THE STUDY OF EARLY MAN (Unit). In establishing a rationale for primary "discovery" the ACSP Newsletter reports the following: "Few would challenge the proposition that even a beginning student might profit from confrontation with the fossil evidence of human evolution." (ACSP, 1965, p. 2) Further, the report states: "If you want to test the hypothesis that young students can work productively with primary data, then you must find ways of bringing data to the classroom." (Ibid.) Charles Merbs, University of Chicago, has accomplished this task of bringing primary source materials into the classroom. He has produced "evidence cards" which contain reliable reproductions of fossil material. The cards are in sets of nineteen and represent accurate specimens of early man; they contain information about the specimens and maps which pinpoint the location of the fossils. Accompanying the cards is a small series of unbreakable casts representing the pelvic bones of chimpanzee, modern man, and Australopitheicus. Transparencies are also used.

Specific problems are presented to the students. Students are asked to determine whether there have been, through time, any significant changes in the size of the grinding area of the dentition. To do this they must arrange the material in chronological order and determine directly from drawings the total grinding surface area of each premolar and molar set. (ACSP, 1965, p. 4) This activity typifies the "discovery" investigation carried out in their study. (An operational definition of "discovery" learning in the IVP follows in a later section of this study.) One portion of the Early Man Study, however, that particularly parallels the work of the IVP is found in the first few days' presentations of the Early Man Unit when pupils are introduced to archaeology as a discipline and to the methods of inquiry used by archaeologists. A Bushman site is used for study. Pupils are introduced to such concepts as archaeology, ecology, culture, artifact, etc. They are presented with a site map and are told that they will examine the site just as the archaeologist might have found it--the artifacts, the refuse, and the environment--and from this evidence attempt to reconstruct the way of life of the people who occupied the site. (ACSP, 1966, p. 4)

The role of the archaeologist as presented to the pupils may be described by the following model.

$^{\text{I}}$ENVIRONMENT — $^{\text{II}}$HUMAN BEHAVIOR = $^{\text{III}}$ARCH. REMAINS

The archaeologist has no access to II, so he must study I and III in order to reconstruct whatever he can of II. The fact, however, that man is a toolmaking, cultural animal makes it possible to learn about him despite the lack of opportunity to observe actual behavior. For it is precisely because man processes so much of his environment into tools and other artifacts which form the residue of his culture that archaeology can reconstruct the behaviors that produced such residues. (ACSP, 1966, p. 4) Typical problems solved by pupils center around the material aspects of the Bushman culture. Illustration of methods used may be provided by a description of the treatment of animal remains.

> Our first task is to sort these remains into general categories such as mammal, bird, reptile, and other. Then, if possible, we should make finer distinctions by identifying these remains as to species--wart hog, giraffe, tortoise, other.
>
> Our second task is to divide the remains into "use" categories such as food, tools, containers, and so on. (ACSP, 1966, p. 2)

Thus, by working in the manner of archaeologists, pupils are made aware of the problems confronting these scientists. The ACSP units provide pupils with learning opportunities using primary source materials. Basically the aims of the Inland Valley Elementary School Archaeology Project are parallel to those of ACSP secondary school units with two major exceptions:

1. The ACSP materials seem highly structured in content and expected outcomes. In other words, predetermined, correct

results have been decided upon. The IVP lessons are structured but to a lesser degree because of the unknown aspects of the actual discoveries to be made. In other words, the teacher as well as the pupils is unaware of the results to be obtained by field excavations.

2. The ACSP units bring primary source materials to the classroom, like the IVP control group, whereas the IVP takes children in the experimental group directly to the field for exploration.

Potyions of the Early Man Study Unit seem particularly akin to the IVP in that parts of both units require considerable involvement of pupils with the methods of inquiry used by archaeologists. As methods of inquiry of the disciplines form an integral part of the nature of the disciplines, this aspect seems especially important. The problems and puzzles presented by archaeology are encountered by pupils in both cases, and pupils in both units are prepared to investigate situations that are really unknown in their entirety.

As to the matter of expected outcomes--as noted above--the ACSP materials seemed to have their sights fixed with steady purpose upon particular outcomes and objectives. Hanvey of the ACSP comments: "In preparation for the analysis of such data, students will ponder some case histories of culture change from more recent times, of more limited scope, with circumstances more fully described. The hope is that they will then be able to approach the archaeological and textual evidence of the cultural transformation of early Mesopotamia with a technical language, with some categories of analysis, with some awareness of hypotheses that might bring a higher level of meaning to that evidence." (ACSP, 1966) In retrospect, Hanvey (1966) states: "But in the Emergence of Civilization we discovered that students and teachers generated enthusiasm which, from our point of view, led them off in wrong directions." (p. 99) Hanvey concludes:

> We are learning. We know now that curriculum materials, if they are open-ended at all, are a kind of projective instrument; teachers confer special and particular meanings on them. But we know, too, that those same materials can provide an educational experience for teachers, leading or at least pointing the way to a level of scholarly autonomy that too few teachers enjoy. (p. 104)

The point here is that while the stated procedures and objectives of the IVP are almost strikingly parallel to those of the ACSP, the former has strived to build in more flexibility of operation. This flexibility is merely the allowance for those personal interests, interpretations, and motivations of teachers and pupils which tend to take them on alternate routes along the way toward major objectives. Hanvey seems almost piqued by the unpredictability of the human element of teacher and pupils in terms of the master plan for the ACSP instructional units.

Science Curriculum Improvement Study (SCIS)

The SCIS under the direction of Robert Karplus works toward the establishment in students of a conceptual structure in science which he terms "scientific literacy" through discovery methods. (Karplus, 1964) Part of the rationale for the SCIS finds support in the psychological theories of Piaget, Vygotsky, Bruner, and others. Fixed intellect and predetermined mental development are denied. Karplus (1964) reports: "Intelligence is a hierarchy of strategies for processing information and schemata for assigning significance to information. This is formed by the experience of the individual. Thus intellectual stimulation during the formative years is as important as natural endowment in determining adult achievement. (p. 6)

In building toward scientific literacy, SCIS attempts to help children build a conceptual framework that permits them to perceive phenomena in a more meaningful way than they would if left to their own devices. It is assumed that a conceptual hierarchy can be established through the study of increasingly complex abstractions, and that the hierarchical nature of the abstractions requires that those abstractions on the earlier levels must be grasped before the ones on later levels can be learned. For example, an understanding of energy transfer depends upon an understanding of interaction, which in turn depends upon the ability to isolate a system and subsystems, which ability is based on the awareness of material objects.

Karplus (1966) lists four levels of instruction for pupil improvement:

> 1. Reading about or being told.
> 2. Discussion, teacher-pupil or pupil-pupil.
> 3. Demonstration.
> 4. Pupil confronts objects and systems he is studying. He manipulates, observes, and acts upon these objects and systems. His findings are his own. (pp. 3-7)

The IVP can be compared with SCIS in its psychological rationale, that is to say in its assumptions concerning Piagetian cognitive development. There is a fundamental commitment to help pupils develop the basic structure of a discipline on their level in both projects. The hierarchy of tasks (abstractions) set forth in SCIS is paralleled to some degree in IVP. Levels of tasks (Gagné) are discussed in another section of this study.

In SCIS child involvement, "discovery" is highly rated: the child confronts objects and systems, he manipulates, he finds out. This is also the essence of IVP. The child manipulates--discovers and learns in a more meaningful way.

One major difference between SCIS and IVP is that SCIS pupils were all in the primary grades (1-3) while IVP pupils were sixth graders. Thus the SCIS children fell into the Piagetian stage of concrete operations while the bulk of IVP children were functioning in the formal operations stage. Therefore, the appropriateness of "discovery" type learning activities is much more firmly established for the SCIS children.

The Elkhart Project

The Elkhart, Indiana, experiment provides an example of a project that defines the structure of the discipline of economics and plans to give developmental instruction in grades one through twelve. Although only primary units are in use now, the ultimate goals of the project provide for a developmental sequence of lessons through grade twelve. Senesh (1960) states: "This experiment rests on the hypothesis that, with proper motivation, children at every grade level, can become excited about the abstract ideas underlying their experiences and that these ideas can be presented in such a way as to reflect the basic structure of economic knowledge. From the first grade to the twelfth grade, the basic structure, in its entirety, is to be presented with increasing complexity and depth as the child moves toward maturity." (Senesh, 1960) The units include statements of concepts accompanied by a statement of curriculum interpretation and student learning activities. Senesh outlines the structure of economics as quoted below.

> 1. All people in all nations are confronted with the conflict between their unlimited wants and limited resources. The degree of the conflict may vary, but the conflict is always present.
>
> 2. From the beginning, men have tried new ways and means to lessen the gap between unlimited wants and limited resources. Their efforts to specialize according to region and occupation and their invention of new machines and productive processes are evidence of their desire to produce more, better, and faster.

3. When people specialize the productive process, they become interdependent. This interdependence creates the need for a market where buyers and sellers can meet and for money which serves as a medium of exchange and as a store of value.

4. In all countries, some of the basic economic questions to be answered are:
What goods and services will be produced?
How much of these will be produced?
How will they be produced?
How much land or raw material will be used?
How much manpower?
How many machines should be used to replace labor?

5. Another basic economic question to be answered is: Who should receive the goods and services produced and in what proportion?

6. In the United States, the free decisions of producers and consumers interact through the market to determine the type and quantity of goods and services produced.

7. Land, labor, and capital are purchased from their owners to produce goods and services. The availability of these "factors of production" and the extent of their use determines who will receive income and how much he will receive.

8. This income is spent or saved; how much is saved and invested determines how much the economy will produce and how many jobs there will be.

9. Public policy (that is, the policy of federal, state, and local governments) modifies the operation of the market system in order to promote the general welfare (a) by encouraging an ever-increasing standard of living for an ever-increasing population; (b) by promoting a high level of employment without inflation; (c) by insuring the continuity of people's incomes against physical and economic hazards; (d) by establishing an environment in which producers have greater freedom to select occupations and in which consumers have greater discretionary power to spend their incomes as they wish; and (e) by lessening inequalities of opportunities and income. (pp. x-xi)

In the Elkhart experiment there is a commitment to the notion that the disciplines can be taught in a meaningful way to a child of any age, provided the subject matter is appropriate to his developmental level. This is exactly what underlies one major assumption in the IVP, that sixth grade children can learn archaeology in a meaningful way. The emphasis on a meaningful structure of the disciplines, as distinguished from a collection of haphazardly related facts, seems to be an integral part of both the Elkhart Project and the IVP. The importance of key concepts in economics is emphasized in the Elkhart materials. It is the clear description of the nature of the structure of economics that is supposed to make that discipline amenable to the kind of developmental, sequential curriculum designed for use in the Elkhart Project. This was the attempt with anthropology in the IVP even though selected aspects of this discipline were utilized. Beginning with a structure of key concepts seems essential.

The foregoing projects relate directly to the IVP in several respects. Primarily, anthropology (in IVP) is treated as a discipline and elements of its structure are taught to elementary school children. Instructional emphasis is on "discovery" learning with primary source materials. The IVP goes beyond both of the previously described anthropology projects in that children were taken into the field to participate directly, in the manner of archaeologists. The Elkhart

Project provides an example in another discipline, i.e., economics, of the direction of emphasis the IVP is giving to anthropology. The importance of the key concepts of a discipline is stressed here. The SCIS provides a rationale which illustrates the importance of Piagetian developmental levels which are basic to the IVP.

CHAPTER III

PROCEDURES

Purpose

The major question to be dealt with in this project is: Can the opportunity to participate in discovery learning by means of an archaeological "dig" significantly enhance the development, in sixth grade pupils, of concepts and principles of archaeology and anthropology as compared with using the same data already collected by someone else and taught in a standard classroom situation?

Description of Activities

During the 1965-66 school year the investigator conducted a pilot program in which groups of elementary school children participated in the excavation of an archaeological site. A total of twenty-seven children participated in this program (nine each from grades four, five, and six). Pupils were selected by individual classroom teachers on the basis of high achievement and general ability.

Instruction was given to pupils by a college student (archaeology major) prior to their participation in the "dig."

This instruction included mainly archaeological field methods of excavation and analysis. The following excavations produced mortars, shells, obsidian chips, and animal bones in abundance, and even two human skeletons.

Although there seemed to be advantages to this kind of enterprise in the learning of anthropology, there was no way to make definitive statements regarding the superiority of this kind of "discovery" learning activity as compared with learning of a much more verbal type carried on in the classroom, i.e., a learning situation in which data from the same "dig" are used but where the teacher elicits and explains concepts and principles in a largely verbal form of teaching method. On the basis of a joint evaluation of the results of this preliminary "dig," it was determined to conduct a systematic excavation of the site under more controlled conditions and to evaluate the results by means of a prepared test. It was felt that a random sample of children on one grade level (preferably sixth grade because these children performed better on the pilot "dig") would produce more stable results than teacher-selected samples throughout three separate grade levels, i.e., fourth, fifth, and sixth.

It was also recommended that pupils in the experiment have more extensive instruction prior to the dig, not only in archaeological methods of inquiry and analysis techniques, but also in background material on California

Indians, as well as anthropological concepts and principles.

During the 1966-67 school year the Inland Valley Elementary School Archaeology Project was carried out in light of the experience with the pilot program. The project was initiated in March 1967. Three instructional units were taught in the following sequence: Ishi, Horizons, Archaeology (see pp. 63-67 for a description of the instructional units). Archaeological excavations were carried out in May and June. A description of the project follows.

Sample

Children from the total sixth grade population at Inland Valley Elementary School were separated on the basis of sex, and were assigned at random from this stratified population into two classes of twenty-eight pupils per class.

One group was designated as the Experimental Group. This group was to participate in learning activities composed of three separate units (see p. 63), the final one of which culminated in an actual archaeological excavation--under the direction of an archaeology major from the University of California, Berkeley.

The second group was designated as the Control Group. This group was to participate in learning activities identical to the experimental group with the exception of the final section of unit III. Instead of going into the field to participate in an archaeological "dig" the control group was to receive instruction of a much more verbal nature--covering the same material that had been encountered by the experimental group at the "dig."

Students in the experimental and control groups were drawn from a total student population from a relatively high socioeconomic environment. A high percentage (approximately 80 per cent) of the parents of the pupils had attended college or university, and in general there appeared to be a compatible relationship between the goals of the school and of the home.

Pupils at Inland Valley Elementary School tend to be atypical in that their average I.Q. tests fall significantly above average national norms. The average I.Q. score of the total sixth grade population at Inland Valley Elementary School was 111 as measured by the Lorge-Thorndike Test administered in October 1966. These I.Q. scores are indicators of academic achievement and as such represent limitations as to the generalization of the results of this study, which will be considered in a later section, i.e., results cannot be generalized to lower I.Q. pupils on a basis of this study.

While it is true that a wide range of academic achievement is represented by the student population at Inland Valley Elementary School, it is also true that the population is generally considered to be middle class in nature and can be assumed to possess the advantages of that group in regard to success in school. In other words, school is important to pupils and parents--success in school is a primary goal.

The Teacher

The teacher selected to participate in this experiment was one who had had five years' teaching experience in the elementary grades, and she was particularly interested in anthropology. She was open-minded, but curious as to the possible results of the projected anthropology study. She had no special emphasis in anthropology prior to her involvement in the Inland Valley Elementary School Archaeology Project.

Class schedules were arranged so that the teacher taught anthropology to both experimental and control groups. Every effort was made by the teacher to equalize instruction. All the lessons in units one and two were taught to both groups together (by means of opening a folding wall between the experimental and control classrooms). The lessons in unit three which required separate instruction, i.e., the experimental group's visitation to the site while the control group received instruction in the classroom, were balanced as closely as possible in terms of planning and organization of lessons and methods of instruction, so that the differences between the experimental and control groups could be attributed to the "dig" as distinguished from the more verbal type of classroom instruction with all other variables reduced to a minimum.

The teacher took special care to avoid incidental learning by her homeroom group (the experimental group) during other class periods, e.g., math, language; however, no attempt was made to restrict pupils' normal relations at recess and other out-of-class times.

Instrumentation

The Prepared Test

Prior to the inception of the Inland Valley Elementary School Archaeology Project, it was determined that it was necessary to devise a test capable of measuring differences between the experimental and control groups in the discipline of anthropology. Specifically, the problem was to produce an instrument which could be used to test differences in the discipline of anthropology which were central to the instructional units. The following cultural invariant categories served as focal points.

FOOD - Any animal or vegatable substance eaten by man. Pertinent aspects include:

1. Types of food naturally available; e.g., acorns, fish, animals.
2. Methods of acquiring food; e.g., hunt, gather.
3. Seasonal factors related to food; e.g., acorn harvest, salmon run.
4. Methods of food preparation; e.g., butchering meat.

CLOTHING - Bodily covering of any kind or amount:

1. Substances from which clothing was produced; e.g., skins, grasses.

2. Methods of manufacturing clothins; e.g., preparation of skins, sewing.
3. Uses of clothing; e.g., functional, ceremonial.

SHELTER - Any form of protection from the elements constructed by man or used by him.

1. Materials used to construct shelter; i.e., what materials are naturally available?
2. Method of shelter construction.
3. Use of shelter; e.g., some shelters were constructed especially for use as sweat houses.
4. Relationship of shelter to climate.

TRADE - Any exchange or bartering of goods between people.

1. Nature of goods traded; i.e., what was naturally available for trading in specific areas?
2. Use of goods traded--functional,ornamental; e.g., obsidian widely traded for use as projectile points.
3. Distance goods were transported from point of origin.

RELIGION - Any belief or practice held by man which involved worship or magical explanations for the unknown.

1. Nature of belief; e.g., Yokuts believed some animals had magical powers.
2. Nature of the ritual; e.g., Rattlesnake Dance.
3. Relationship between belief or ritual and practical aspects of life; e.g., Ishi ritualistically fasted prior to a hunt. The resultant inhibition of his body odor enhanced his chances for killing deer.

TOOLS - Any implement used by man for accomplishing any specific task.

1. Material used to make tool; e.g., obsidian for drill.
2. Method of manufacture; e.g., flaking process to produce projectile points.
3. Nature of the tool; i.e., uses to which it was put.
4. Technology--relationship of tool to increased productivity; e.g., efficiency of obsidian drill in making holes.

Development of the Prepared Test

One basic test form was devised and subsequently revised twice. It utilized one section of terms which the respondent was asked to define, and one section composed entirely of multiple-choice items. This test was finally discarded owing to the specificity of knowledge required of the students in responses; it was believed questions designed to sample understanding as distinguished from specific facts would serve the purposes better.

A subsequent test form was devised which eventually became the instrument used to measure differences between experimental and control groups in the IVP. This test form was based entirely upon short essay type responses to a variety of questions.

The investigator contacted the Anthropology Curriculum Study Project in Chicago and obtained permission to use an archaeological site map (of a relatively recent Bushman site on the Kalahari Desert) which the ACSP had used as a portion of the EARLY MAN STUDY (ACSP, 1965). Through the use of this site map it was possible to construct short essay type questions about food, clothing, shelter, trade, and religion of a primitive society which was not related to the California Indians. Questions in this section of the test required pupils to examine sketches of artifacts and form hypotheses about their use on the basis of information provided on the site map (see attachment #1, Section I, Parts I and II).

A second section of the test asked children to respond to similar kinds of short essay questions, but with more of an orientation to American Indians as distinguished from general questions about primitive societies or Bushman-oriented questions. For example, a bison bone is found in association with prehistoric Indians in Illinois. What conclusions can be made about this?

Part II of Section II of the test was composed of five essay questions designed to test in depth for specific archaeological information; for instance, how to excavate a skeleton.

The final form of the prepared test was constructed with two major guidelines in view: 1. To produce an instrument which would allow the student who was relatively unsophisticated in the discipline of anthropology to achieve a feeling of success when dealing with the pretest. The following test item illustrates this purpose.

> Q. How do you think California Indians got their food? What reasons do you have for thinking this?
>
> A. Hunted, gathered. Because of artifacts found, reading source.

It is obvious that pupils should be able to answer this question from a fund of general information about Indians, and hunting or other means Indians used in acquiring their food.

2. To provide test situations in which pupils were required to go beyond the recall of specific understandings. In other words, situations were supplied which required pupils to apply previously learned concepts to essentially novel or new situations and to form generalizations. The following question, I, II, #4, illustrates the achievement of this purpose. The pupil was provided with a map (see attachment #2) of a Bushman site in the Kalahari Desert in Africa. He was given background information and asked to study the map to answer the question:

Q. What do you think the people ate? Why do you think so?

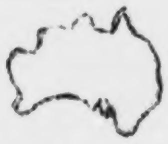
On the posttest, pupils were tested after being taught understandings about specific primitive groups, specifically, California Indians. They came to the test situation with specific knowledge of foods and food gathering practices of California Indians. The test problem calls for the application of concepts (learned about California Indians) to a group of primitive people whose practices were essentially similar to those of California Indians in many respects, but where the recall of specific facts previously learned would not suffice. For instance, an answer stating that these people ate acorns and salmon obviously would be incorrect. Pupils having understandings about hunting- and gathering-primitives would immediately determine on the basis of information provided that this was such a group of people, but more importantly they would interpret the data in terms of the situation given.

A. Nuts, animal meat, tortoise, eggs. Because of the presence of shells, bones, tortoise-shells, eggshells.

This correct answer shows successful application of previously learned concepts to the new situation.

By way of comparison, several questions from a standardized social studies test are given.

Q. This is an outline map of



(a) India
(b) China
(c) Egypt
(d) Australia

A. d

Q. Which of these is the greatest industrial state?
(a) Ohio
(b) Tennessee
(c) Massachusetts
(d) Pennsylvania

A. d

Q. The most outstanding mineral resource of the deserts of the Middle East is
(a) cobalt
(b) nitrates
(c) uranium
(d) oil

A. d

The purpose of listing the above standardized test items is twofold. First, success on these items indicates the ability to recall specific facts or to make lucky guesses on the part of the respondent. It is the opinion of the investigator that the prepared test used in this study overcomes the problem of success by lucky guessing and in addition calls for the pupil to show a higher level of understanding; i.e., applying understandings to new situations. Secondly, as noted in the Analysis of Data section of this study, success on the social studies portions of this standardized test has a high correlation with pretest scores, while a low correlation is shown between standardized social studies test scores and the prepared test. The investigator maintains that these relationships provide evidence that the prepared instrument does, in fact, test for understandings significantly beyond the recall or guessing level.

The prepared test was given to a group of thirty children from the Sleepy Hollow School in Orinda. Sleepy Hollow School was selected for pilot testing because of the similarity between it and Inland Valley Elementary School in socioeconomic background of the residents and ability levels of the pupils. The children were selected by their teachers so as to provide representative sampling of ability levels; ten high I.Q., ten average I.Q., and ten low average to low I.Q. pupils were selected. Following the completion of the test by the Sleepy Hollow group, all responses were typed and grouped together by question. Each question was then analyzed in terms of its effectiveness: whether it showed differences between high and low pupils. In this manner items were deleted from the test, or in some cases wording of individual items was altered to clarify the intent of the question.

It should be noted that several test items were easily handled by students at all I.Q. range levels; these items were purposely left in the test to provide the opportunity for all pupils to have some feeling of success on the pretest.

Scoring the Prepared Test

The investigator and the teacher of the experimental and control groups prepared standards for test responses which were based on a four-point scale for each question. That is to say, each question on the test was worth four points if fully and "correctly" answered. Partial answers were given credit on the basis of their completeness of three points, two points, or one point. The standards for the test responses were prepared in written form so as to provide a consistent measure against which answers could be scored by an independent person (see attachment #3).

The investigator and one other person (a former elementary school teacher) scored all tests together according to the above described standards. Scores were arrived at by consensus of the investigator and the other person in the grading team in light of test standards.

Independent Scoring

An elementary school teacher who had no connection with this project was contacted for the purpose of providing an independent score on the prepared test. This person was provided with the standards for scoring which are described above and given verbal instructions on scoring procedures. (The investigator met with this independent scorer for approximately three hours to review procedures.)

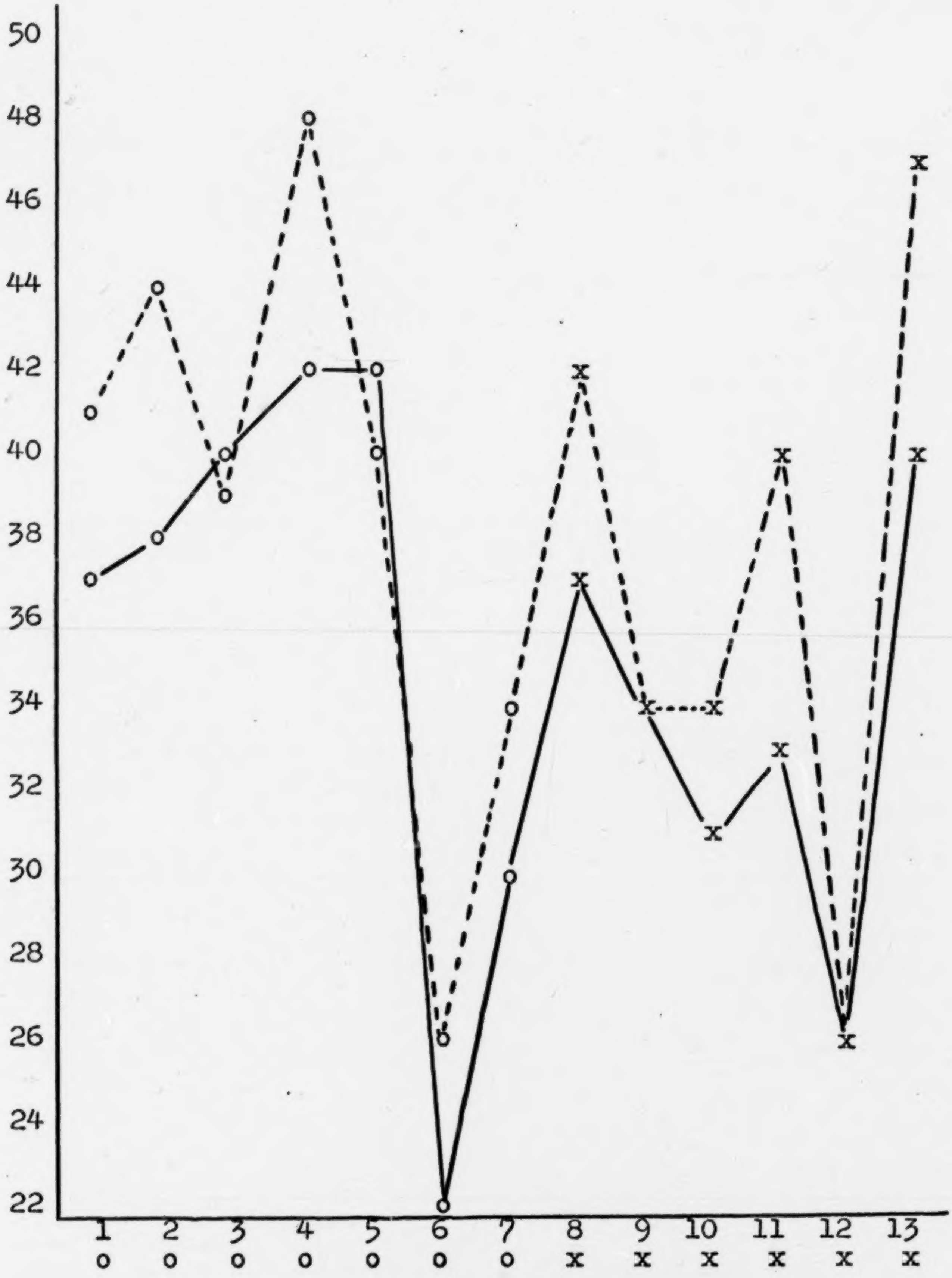
The independent scorer was given 25 per cent of both the pretest and posttest for grading. Her grades showed a high positive correlation with the grades of the investigator's scoring team.

Thus the devised test was carefully prepared and found to be capable of producing a high positive correlation between separate scorers. Correlations between scorers were made using the Bivariat Frequency Plot.

The pretest inter-rater correlation was .90 (see chart #1). The independent rater generally scored the pupils higher on the pretest than did the investigator's scoring team although there was a relatively close relationship between both sets of scores.

The posttest correlation between scorers was .96 (see chart #2). On this part the investigator's scoring team generally scored the pupils higher than did the independent rater, but ratings were close.

CHART # 1

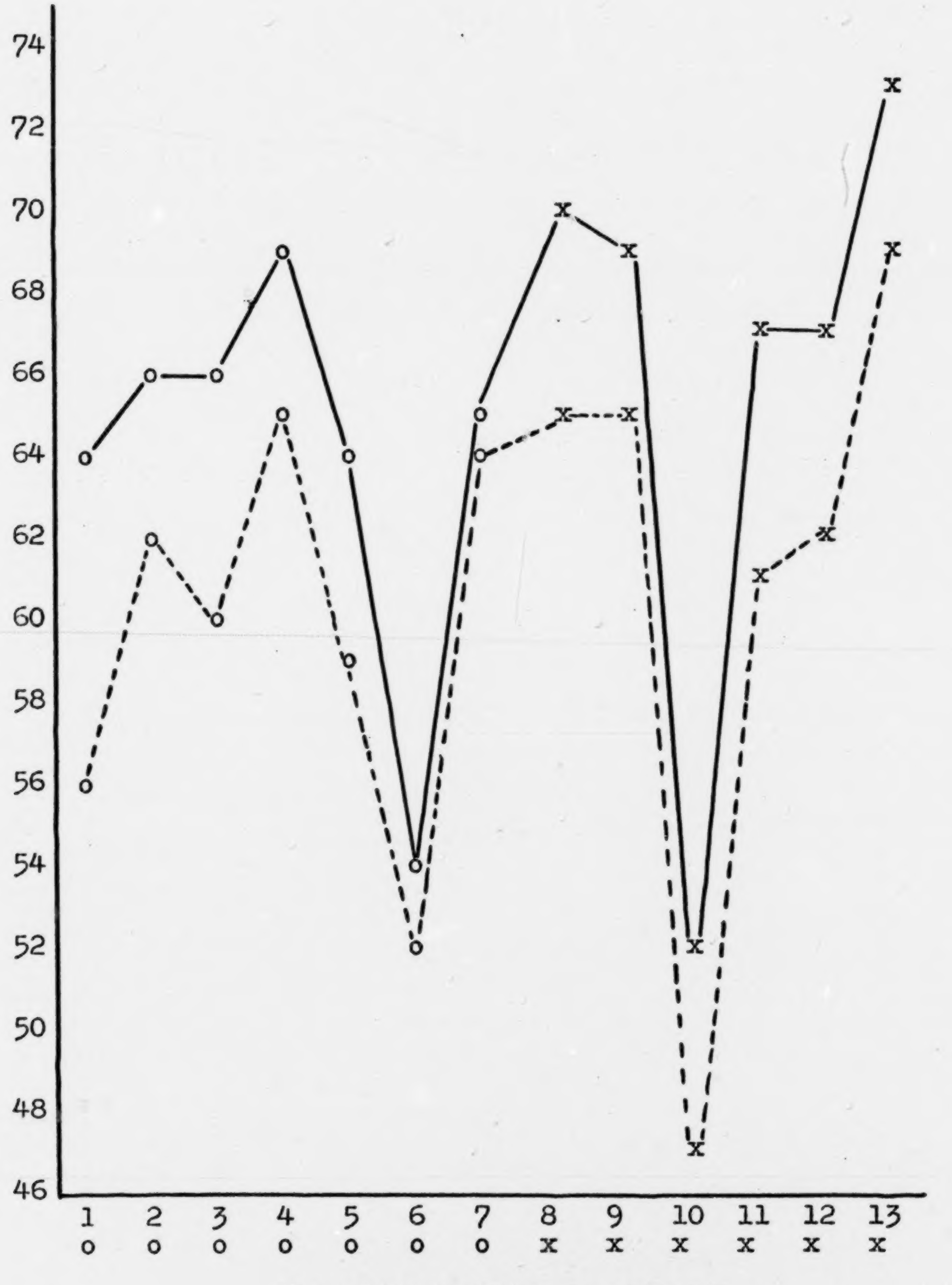


Correlation between scorers
on Pre-test total = .90

o - control
x - experimental

—— Solid line first scorer
--- Dotted line second scorer

CHART # 2



Correlation between scorers
on Post-test total = .96

o - control
x - experimental

—— Solid line first scorer
--- Dotted line second scorer

The generally high correlation between ratings on both pretests and posttests tends to eliminate the possibility of bias on the part of the investigator's scoring team. The high correlation also shows that the independent rater was instructed in the use of a standard for scoring the test that she was able to apply consistently to both the experimental and the control groups alike. The independent rater was unable to identify pupils, the groups to which pupils belonged, or the grades given by the investigator's scoring team. Her judgments concerned simply the grading of answers to questions according to a previously established set of standards. These efforts to ensure the complete independence of the independent rater lend strength to the correlation obtained between the separate scores. It is the investigator's belief that the care taken in the procedures of scoring add to the total credibility of the experiment and enhance the significance of results which were found in favor of the experimental group.

Procedures of Experiment

Testing Schedule

Lorge-Thorndike I.Q.	October 1966	Administered by teacher
Stanford Achievement Test	October 1966	Administered by teacher
Prepared Test Pretest	March 1967	Administered by teacher and investigator

Prepared Test Posttest	June 1967	Administered by teacher and investigator

Instructional Units

Three units were taught in the same manner to both treatment groups. These units were especially prepared to provide pupils with the necessary background of information (appropriate concepts and generalizations) in anthropology to participate in this experiment in a meaningful way in the manner of archaeologists. That is, a basic understanding of the way of life of California Indians in general, plus an understanding and appreciation of the past archaeological periods of California Indian history (Horizon periods) was expected to enhance the actual excavation activities carried out by the pupils.

The following units are listed in the order of their presentation to pupils.

1. ISHI UNIT. In the Ishi unit the pupils in the experimental and control groups were exposed to as complete a picture of the life of one California Indian tribe as possible. The ethnographic records of Waterman and Kroeber provided a comparatively complete overview of the culture of the Yana tribe. As noted above, focal points rested upon food, shelter, clothing, trade, religion, and tools, but considerable additional information of a non-material nature was incorporated into the Ishi units; for example, aspects of

the Yana number system and language were studied. All lessons were taught to both experimental and control groups at the same time by the same teacher.

As noted earlier, the intent with the Ishi unit was to provide a comprehensive picture of Indian life while bringing into focus those elements of Indian culture which were to be presented in later units for which much less information was available.

2. HORIZONS UNIT. California Indian pre-history is divided into three periods primarily on the basis of differences in cultural activities as evidenced by the changes in tools, weapons, and implements, and other artifacts over the periods of time. For example, the earlier Indians depended much more upon henting than did later groups; this is determined in part by the number of projectile points and mortars discovered. In this unit pupils studied Indian cultures on the basis of more meager information than was available in the Ishi unit. Knowledge of the cultures of the middle and early Horizon Indian societies comes entirely from the records of archaeologists' finds. Thus, as noted earlier, the knowledge of these early societies consists of aspects considered to be primarily material in nature: food, clothing, shelter, trade, tools, with certain inferences and conclusions.

More specifically, the pupils were led to recognize similarities and differences between the Horizon periods;

e.g., in early Horiaon period burials, the bodies were extended while in middle Horizon they were flexed. Both cultures had mortuary practices that were similar, but the distinctive differences in the way corpses were entombed instantly alerted the students to look for other clues for a particular Horizon period.

Thus an overview of the cultural periods of California Indian history in the Horizons unit was provided, together with some acquaintance with techniques of archaeology. All lessons were taught to both treatment groups at the same time by the same teacher.

3. ARCHAEOLOGY UNIT. All pupils in both treatment groups were taught the fundamentals of the methods of inquiry used in archaeology. For example, site survey and mapping techniques were taught along with methods of site excavation. Pupils were instructed in the recognition of artifacts and features. These lessons were taught in the same manner as in the previous units. Both experimental and control groups were instructed at the same time by the same teacher.

Upon completion of the above described portion of the archaeology unit the experimental group went into the field and participated in the excavation of a California Indian site. This excavation was carried out under the direction of an expert archaeologist. The pupils worked in the manner of archaeologists, mapping, excavating, identifying, and interpreting in the field.

The control group received instruction in the classroom that covered the identical material studied by the experimental group in the field. Mapping exercises were carried out, excavation techniques reviewed, and pupils were shown artifacts retrieved from the site; they were encouraged to form hypotheses on the basis of the data that were utilized by the experimental group in the field. The sole difference was participation in the "dig" by the experimental group as opposed to learning the same things in a classroom situation, i.e., in a much more verbally oriented manner.

It is noted at this point that the major difference between treatments was participation in the "dig" as distinguished from nonparticipation. Although the experiment was set in terms of "presentational" vs. "discovery" learning, the teacher of the treatment groups did not change her pedagogical style when instructing the control group. Even though control group instruction was mainly of a verbal nature, the standard classroom procedure of the teacher included questioning of the pupils (getting them to hypothesize) as a strategy in addition to telling and explaining. (See Presentational Operational, p. 70) Thus wher we say "discovery" vs. "presentational," we mean discovery methods in the field as distinguished from a much more verbal operation in the classroom--not an artificially created classroom situation in which all possible "discovery" activities have been deleted.

The "dig" itself was more time-consuming than was the classroom instruction given to the control group; this was as expected. The disparity in time was approximately one hour control group instruction to four hours experimental group instruction. No attempts were made to match time between the groups in terms of hours spent. At the termination of the IVP lessons the control group simply went on to other school activities not related to the project. Such a disparity in time is assumed to be of only secondary interest in terms of this study, although the possible influence of time differential between treatment groups has not been disproved.

The teacher was oriented in terms of "teaching the lesson" without regard for time spent. The major intent was to determine possible differences produced by participation in the "dig," with other variables controlled except time duration.

To recapitulate, both the experimental group and the control group had identical treatment, insofar as possible, up to the point of the actual "dig." The experimental group performed actual excavations while the control group received more standard classroom instruction; that is, the latter were shown artifacts and guided to interpret and form hypotheses by "standard" classroom methods. All activities of the experimental and control groups were balanced as closely as possible. (The same teacher gave instruction to both groups.)

To illustrate the difference between learning activities of the experimental and control groups, a definition of discovery and a brief description of the typical learning activities of each group follow.

Definition of "Discovery"

"Discovery" is defined as a mode of inquiry by which pupils proceed inductively from data to concepts, principles, and generalizations. This process is carried out through such activities as excavating and examining artifacts in the field, formulating and checking hypotheses, and evaluating conclusions in light of existing archaeological research findings.

Discovery (Operational)

The children in the experimental group performed in the field in the manner of archaeologists. Neither the children, nor the teacher, nor the archaeology consultant was aware of the ultimate findings. The pupils excavated data and formed hypotheses; they "discovered." For example, a child picked up obsidian. He felt it and looked at it. He noted such characteristics as shape, sharpness, dullness, thickness, color, hardness. He compared these within his mental frame of reference; e.g., obsidian is like dark glass. All children possess different levels of conceptual understanding. Most children know the nature of volcanic rock in this form, i.e., obsidian. Others are at a lower level and have ideas only about glass. The levels of ideas possessed by the children are readily apparent to the teacher.

In anthropology the child has reached a point where his preconceived notions about tools, burials, etc. have been altered. In effect, he has a new orientation about these concepts which has been provided by the Ishi unit and the Horizons unit. Both tool and burial, etc. have been broadened in scope. He categorizes his ideas about obsidian according to his new frame of reference regarding tools, weapons, utensils. He recalls uses of obsidian and can even think of new uses. He is cautioned to avoid wild guessing. In the Ishi unit he has learned about obsidian used as arrowheads. Upon finding an obsidian scraper he should be likely to go beyond what he knows about obsidian arrowheads, to make some good guesses about the scrapers.

Through Ishi and the Horizons units, the pupil has had his concepts broadened, and in the case of obsidian he has become acquainted with the distinguishing properties of the stone. In working in the field in the manner of an archaeologist he discovers for himself. He finds obsidian, adapts it into his mental framework, and makes his own hypotheses about its use.

Presentational (Operational)

The pupils in the control group possessed the same background as the experimental group up to the point of the "dig." At this juncture the control group received instruction identical with that of the experimental group except that this instruction took place entirely in the classroom and was largely (but not entirely) verbal in nature. This instruction was based on the findings of the experimental group and utilized those materials taken from the site. One important distinction between treatment groups was that the teacher of the control group was aware of the ultimate results to be achieved by instruction because the experimental group had already studied this material under her direction.

A description of typical control group activities follows. An obsidian arrowhead, or scraper, or picture of one is shown to the class. Essentially the children are made aware that the material is hard, sharp, used extensively for arrowhead manufacture and other kinds of tools and weapons. The teacher and pupils have an interchange of questions and answers, a discussion. The teacher relates the present lesson to the Ishi unit and the Horizons unit, verbally building upon concepts previously established in the Ishi and the Horizons unit. The pupils are taught the same ideas in a more verbally oriented form as distinguished from a lesson involving children in a discovery learning experience in the field. It is noted, however, that although this type of learning activity is more verbal than the discovery (operational) previously described, it still involves an exchange between pupil and teacher: the teacher questions pupils and encourages them to form hypotheses.

Thus the distinction between treatment groups is seen in terms of "dig" vs. "non-dig," and is viewed within the issue of presentational vs. discovery learning in terms of degree. Pupils working in the field in the manner of archaeologists function in a primarily discovery-oriented learning situation as distinguished from control pupils who learn in a largely verbal way in the classroom. No attempts were made to strip all discovery characteristics from pedagogical strategies employed in the classroom.

CHAPTER IV

ANALYSIS OF DATA

This chapter contains the results of statistical comparisons of experimental and control groups on the basis of the following variables:

Lorge-Thorndike I.Q. Scores (Test administered October 1966)

Stanford Achievement Test Scores (Test administered October 1966)

word meaning
paragraph meaning
total reading
spelling
language
arithmetic computation
arithmetic concepts
arithmetic application
social studies

Anthropology Pretest Scores (Test administered March 1967)

Anthropology Posttest Scores (Test administered June 1967)

The following analysis shows the relationship of treatment groups on the Lorge-Thorndike I.Q. Test, Stanford Achievement Test, and the pretest prior to experimental treatment. Posttest scores between treatment groups are also analyzed. The t test was utilized in making these comparisons. (Rummel, 1964, pp. 369-70)

Results of the Stanford Achievement Test subtests in social studies are discussed below in terms of their correlation with pretest and posttest scores of both treatment groups. The Pearson product-moment correlation coefficient was utilized. Scatter diagrams were also prepared (see charts #4 and #5, pp. 74 and 75). (Rummel, 1964, pp. 354-57)

All data were processed by the IBM 7094 computer at the Computer Center, University of California, Berkeley, employing STATPAK, a library of statistical programs.

I.Q. Scores

Lorge-Thorndike verbal I.Q. scores obtained in October 1966 were compared for the experimental and control groups. The test of significance between the mean I.Q. scores of the two groups was made using the _t_ test. (See chart #3 below.) No significant difference between mean I.Q. scores of experimental and control groups was found.

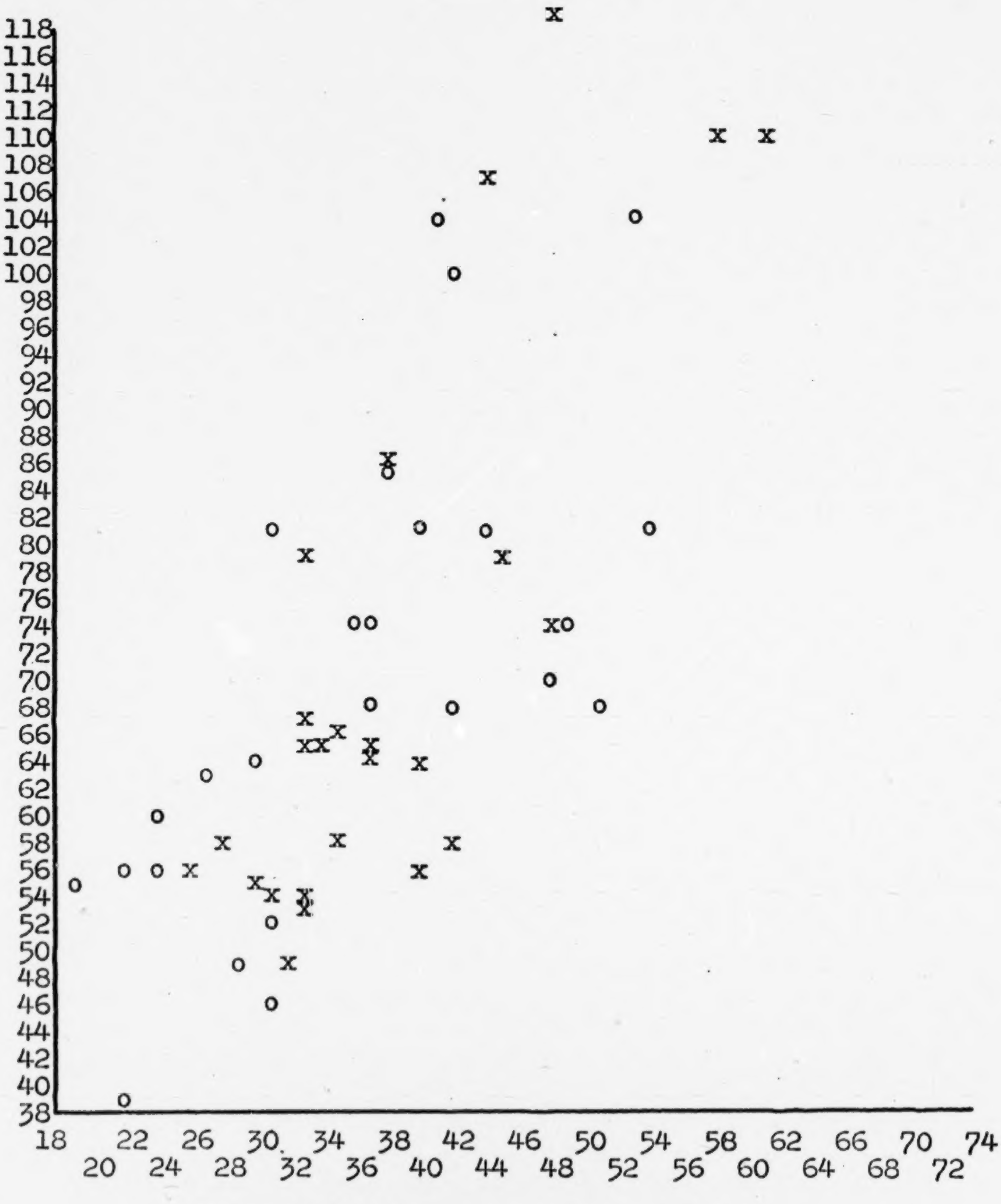
CHART #3

A COMPARISON OF EXPERIMENTAL AND CONTROL GROUP MEAN SCORES ON THE LORGE-THORNDIKE I.Q. TEST SCORES ADMINISTERED OCTOBER 1966 USING THE _t_ TEST

Experimental $\bar{X}$	Control $\bar{X}$	_t_ Statistic	DF	Significance Level
119	114	-1.533	49	$.10 < .20$

Note: Differences were not found to be significant at the .05 level.

CHART # 4

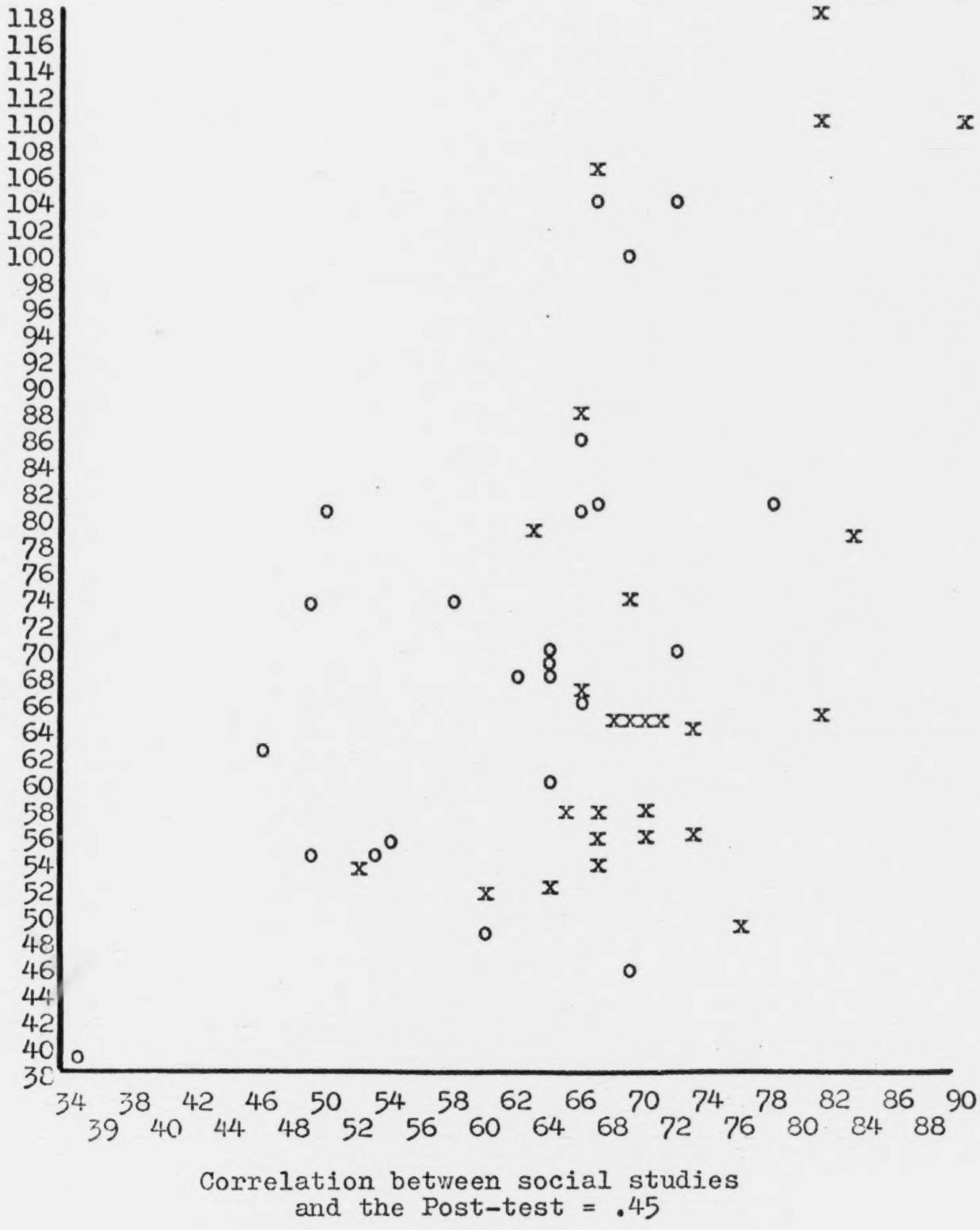


Correlation between social studies
and the Pre-test = .73

Social Studies scores - vertical
Pre-test scores - horizontal

O - Control
X - Experimental

CHART # 5



Correlation between social studies
and the Post-test = .45

Social Studies scores - vertical
Post-test scores - horizontal

O - Control
X - Experimental

Achievement Test Scores

Stanford Achievement Test scores obtained in October 1966 were compared for experimental and control groups. The test of significance among the subtest mean scores of the two groups was made using the *t* test. There was no significant difference between mean scores of experimental and control groups in any of the areas tested (see chart #6).

CHART # 6

A COMPARISON OF EXPERIMENTAL AND CONTROL GROUP MEAN SCORES ON THE STANFORD ACHIEVEMENT TEST ADMINISTERED OCTOBER 1966 USING THE T TEST.

	Experimental $\bar{X}$	Control $\bar{X}$	T Statistic	Significance Level
Word Meaning	71.0	69.2	-0.470	$>.50$
Paragraph Meaning	74.2	72.1	-0.416	$>.50$
Total Reading	72.7	70.7	-0.502	$>.50$
Spelling	71.5	72.0	0.111	$>.50$
Language	73.4	73.7	0.057	$>.50$
Arithmetic Comprehension	60.0	61.0	0.270	$>.5$
Arithmetic Concepts	75.9	73.4	-0.594	$>.5$
Arithmetic Application	70.2	74.5	0.742	$.2 < .5$
Social Studies	70.8	70.4	-0.087	$>.5$

NOTE: No statistically significant differences were found between treatment groups in any subject area at the .05 level.

49 degrees of freedom for all cases.

Comparison of Social Studies and the Prepared Test Scores

Results of the social studies subtest were compared with the prepared anthropology pretest and posttest for both experimental and control groups. It was found that the social studies scores and the pretest scores had a positive correlation of .73 (see chart #4, p. 74); the social studies scores and the posttest scores had a positive correlation of only .45 (see chart #5, p. 75).

Prepared Test Scores

As reported earlier, the testing instrument for knowledge of archaeology and anthropology was prepared in two sections with each section composed of two parts. Chart #7 indicates the sections and number of questions in each.

CHART #7

OUTLINE OF
PREPARED ANTHROPOLOGY TEST

SECTION	PART	NUMBER OF QUESTIONS	POINTS
I Bushman Site	1 Artifact Interpretation	5	20
	2 Site Map Interpretation	14	56
II California Indians	1 California Indians Data Interpretation	12	48
	2 Archaeology Methods of Inquiry	5	20
TOTAL		36	144

Each question on the total test was rated on a four-point scale (see Scoring, p. 58). Total scores were obtained for all pupils in both experimental and control groups for all questions on both the pretest and the posttest. Sub-scores were also obtained for all separate parts of both sections. All scores were adjusted to a 100 per cent scale and compared for differences between experimental and control groups in terms of total scores and subtest scores. The following paragraphs recapitulate the statistical analysis for all parts of the test.

Pretest

Mean pretest scores for all parts of both sections of the test were compared using the t test. No statistically significant differences between experimental and control groups were found at the .05 level (see chart #8).

Posttest

Posttest scores are presented in tabular form on chart #9.

Section I, Part I. The test of significance between the mean scores of the experimental and control groups was made using the t test (see chart #9). No significant difference was found between groups on this section of the test. Section I, Part II, and Section II, Parts I and II, were compared using the t test. A statistically significant difference favored the experimental group on all parts.

CHART # 8

A COMPARISON OF EXPERIMENTAL AND CONTROL GROUP MEAN SCORES USING THE T TEST

THE PREPARED ANTHROPOLOGY TEST (PRE-TEST)

	Experimental $\bar{X}$	Control $\bar{X}$	T Statistic	Significance Level
Section I Part I	36.7	45.4	-1.692	$.05 < P < .10$
Section I Part II	42.0	44.2	-0.560	$P > .5$
Section II Part I	38.7	39.3	-0.150	$P > .5$
Section II Part II	9.61	12.0	-1.426	$.10 < P < .20$
Total of Sections I & II	38.3	35.7	-0.992	$.20 < P < .50$

NOTE: 49 degrees of freedom for all cases.

No significant differences were found in any of the above sections at the .05 level.

CHART #9

A COMPARISON OF EXPERIMENTAL AND CONTROL GROUP MEAN SCORES USING THE T TEST.

THE PREPARED ANTHROPOLOGY TEST (POST-TEST)

	Experimental $\bar{X}$	Control $\bar{X}$	T Statistic	Significance Level
Section I Part I	62.6	57.3	-1.053	$.20 < P < 50$
Section I Part II	70.6	57.6	-4.109	$P < .01$
Section II Part I	82.5	75.9	-2.488	$.02 < P < .01$
Section II Part II	50.8	38.3	-2.567	$.02 < P < .01$
Total of Sections I & II	70.7	61.0	-3.967	$P < .01$

NOTE: 49 degrees of freedom for all cases.

The total of all sections was significant at the .05 level.

CHAPTER V

DISCUSSION OF RESULTS

The comparability of the two treatment groups was established at the outset of the study on the Lorge-Thorndike I.Q. Test, the Stanford Achievement Test, and the pretest. Therefore the statistically significant differences obtained on the posttest are attributed to the superior performances on the part of the experimental group as a result of different treatment, i.e., "dig" vs. "non-dig." This section will consider the prepared test in detail and will examine the implications of the differences found on the posttest as well as other relationships between experimental and control groups that have a bearing on this study.

Discussion of Prepared Test Items

An item by item analysis of student performance on the prepared posttest follows. Total points scored on each item were computed for both the experimental and control groups. These scores provided the basis for a description of items using the criteria of whether experimental or control group scored higher.

Section I, Parts I and II are preceded by explanatory remarks which provide a background of information necessary to the use of the site map in answering questions.

> An important part of learning about other cultures involves making good guesses about the tools, implements, and other things that the people used. (These things are called artifacts.) The following questions will give you the opportunity to make guesses about artifacts. Some items will seem easy to guess and others more difficult. Study your site map carefully before writing your answers. As you look at the artifacts and study the map, think carefully about what the items were possibly used for, the particular way in which they might have been used and by whom. When artifacts were used is also important--in other words, some tools were used only during certain times of the year. (See attachment #1)

The question which follows is representative of the five questions in Part I of Section I. In this section the children were required to bring their skills and understandings to bear upon the interpretation of sketches in what was essentially a new situation.

1. Number 6 printed at the top of your site map states: Curved stick, pointed end. Tell what you think this is and why. (Give some reasons for your idea.)

A. A bow (hunting). The shape indicates that it is a bow. Other reasons are also accepted; e.g., a quiver appears to be nearby on the sketch. (See grading standards, attachment #3)

This portion of the test required children to demonstrate understandings of anthropological concepts, as opposed to recalling specific facts. All parts of the test were geared to the instructional units which were based on a structure of anthropology described earlier. In other words, questions regarding cultural invariants were central to all sections of this test.

To illustrate further the matter of testing children's understandings we refer again to the above question. Note that this question, as do all others, stipulates that the pupil give reasons for his answers. The sketch itself does not immediately suggest a bow. It could be a sharp stick for digging purposes (as a number of children responded) or an implement used for other purposes in the primitive camp, for instance, stirring a fire. The typical correct response did see the curved stick as a bow (because of its shape) or because of its association with what might be a quiver and projectile points. The investigator feels that the response "because of its shape" really must be viewed in the total context of the test situation; i.e., introduction to the test and the map of the Bushman site. It would be interesting to know what responses the children would make to this question if the curved stick were placed in a setting of instructions on how to make a kite.

Some typically incorrect responses to this question either failed to recognize the stick as a bow, or recognized it as a bow and gave inappropriate reasons.

Questions 2 through 5 of Section I, Part I are listed below.

2. Tell what you think number 9 is and why. (Give some reasons for your idea.)

3. Tell what you think number 16 is and why. (Give some reasons for your idea.)

4. Tell what you think number 20 is and why. (Give some reasons for your idea.)

5. Tell what you think number 2 is and why. (Give some reasons for your idea.)

It can be seen that all the questions in Section I, Part I require children to interpret data and form hypotheses. General problem-solving ability produced positive results as shown by pretest scores. However, instruction in the anthropology units (described previously) enhanced scores of both experimental and control groups--indicated by comparison of pretest and posttest scores.

A breakdown of items in Section I, Part I follows (posttest scores):

Question 1. The control group scored higher than the experimental group on this question.

Question 2. The experimental group scored higher than the control group on this question. The most significant error of those missing the question involved pupils telling what they thought the item might have been used for as distinguished from what the question actually asked; i.e., "What is number 9? How do you know?"

Question 3. The experimental group scored higher than the control group on this question. Pupils with lower scores tended to confuse spear with arrow and gave inadequate or inappropriate reasons.

Question 4. The experimental group scored higher than the control group on this question. Pupils with higher scores tended to give better reasons. For instance, "A hammerstone, because of chipped places, or pecking marks."

Question 5. Both groups showed equally low scores on this item. The relationship between the "thin wooden wand, polished on one end," and its use as a fire-making instrument seemed too remote for both experimental and control groups.

_t_ test results showed no significant difference between experimental and control groups on this section of the test.

Although no definite statements can be made, it appears that question 1 was more easily solved by general problem-solving ability than were numbers 2, 3, and 4. Question 5 appears to have been equally difficult for both groups, thus producing equivalent low scores.

Generally speaking, the differences between correct and incorrect responses on Part I fell in the area of giving reasons for answers.

Section I, Part II utilized the site map also. Questions were geared to elicit responses, in this new situation, to those basic concepts of anthropology central to the instructional units. Concepts of food, shelter, tools, and religion are specifically developed in this section (see attachment #1).

Question 1. What must all people have in order to survive?

This question received an equivalent high score from both experimental and control pupils. The question was of a general nature designed particularly to provide success on the basis of general information and problem-solving ability.

Question 2. How old do you think the site is?

This question showed a difference in favor of the experimental group. The experimental group pupils seemed more able to pick up specific clues, such as the presence of metal at the site and the fact that artifacts were on the surface of the ground. The control group pupils seemed to fall behind in that they considered the nature of the artifacts to indicate great age as distinguished from presently living primitive people.

Question 3. Would you call this a hunting, gathering, or an agricultural society? Why do you think so?

This question showed some advantage in favor of the experimental group, but in general the controls did well.

Question 4. What do you think the people ate? Why do you think so?

This question showed considerable difference in favor of the experimental group. Some incorrect answers indicated that the people ate shells. This question, as do others of this type in which experimental children perform better on the interpretation of evidence, appears to suggest that the experimental group pupils bring a more secure understanding of concepts to the test situation than do the control group pupils. Pupils answering incorrectly seemed to revert to a scramble of general information when they were unable to apply specific understandings to a situation; for example, the anthropological understandings taught in the units were not learned well enough. This same pattern seemed to typify those children of both groups who responded incorrectly. A major difference is that the experimental students were correct in their responses a significantly greater number of times.

Question 5. How do you think they obtained their food?

This question seems to have been answered about equally as well by both groups.

Question 6. What do you think the people manufactured? (goods, tools, etc.)

This question showed superior scores for the experimental group. Typical incorrect answers were not complete enough. Some copied goods, tools, etc. from the question itself. The experimental group pupils seemed to have a more realistic conception of what goods could reasonably be made by a primitive people.

Question 7. How many people do you think lived in the site? How do you know?

This question showed superior scores for the experimental group. These pupils seemed much more able to estimate family size on the basis of shelter remains, even considering that the site they excavated was a cave and no post molds were found. The number of hearths seemed to be a factor which confused control pupils.

Question 8. Do you think these people had fire? What reasons do you have for your idea?

This question received essentially equivalent responses from both groups. The difficulty level of this question seemed to provide a high level of success for all; i.e., the evidence for reasons is much easier to discern--fire pits being a dominant feature of most areas of the site map.

Question 9. If these people had fire, how do you think they obtained it? What reasons do you have for your idea?

This question showed scores favoring the experimental group. Although the question was related to number 8 in that it asked about fire, it was a harder question in that evidence showing how fire was made was more difficult to determine.

Question 10. How do you think food was prepared? What reasons do you have for thinking so?

This question showed scores favoring the experimental group. Generally these pupils gave more complete answers than did the students in the control group. The control people picked up fewer clues as to how food was prepared.

Question 11. Do you think there is any evidence of religious or recreational ceremonies? What evidence do you see?

This question showed scores favoring the experimental group. The essential difference between pupils answering correctly and those giving wrong answers seems to be the recognition of the tamped area around a hearth, or the failure to see this as a clue. Experimental group pupils were more discerning in this regard.

Question 12. In what kind of dwellings do you think the people lived?

This question yielded results favoring the experimental group pupils. Making correct guesses about post molds was an essential in making correct responses. Wrong answers seemed particularly divergent from the correct responses; for example, "They lived in caves."

Question 13. Do you think the people had domestic animals? What are your reasons for thinking this?

This question showed scores favoring the control group. The experimental group seemed to miss this question because they interpreted the presence of bones and hide as evidence of domestic animals. Although this response is entirely reasonable, it is not correct. Pupils answering correctly ignored this evidence.

Question 14. Do you think there was a chief or tribal leader of the group? What are your reasons for your ideas?

This question seemed to draw a relatively low level of correct answers from both groups. Lacking evidence of a chief or tribal leader, pupils in both groups seemed prone to fall back on previous general knowledge such as, "Yes, all people need leaders."

Section II, Part I of the prepared instrument emphasizes questions central to religion, trade, and food, with questions regarding the general nature of California Indian culture and human adjustment. The questions are designed to require pupils to form hypotheses or draw conclusions and give reasons. The intent was to require more than the recall of specific facts or knowledge, and to go beyond to the level of expressing understandings. For the most part, the questions represent new problem situations for the pupils.

Question 1. How do you think California Indians got their food? What reasons do you have for thinking this?

This question showed high scores for both groups but higher for the experimental group. The pupils responding incorrectly usually responded with incomplete answers.

Question 2. California Indians were divided into groups called Horizons.

Early Horizon Indians lived from 4000 to 2000 B.C.
Middle Horizon Indians lived from 1500 B.C. to 700 A.D.
Late Horizon Indians lived from 700 A.D. to 1600 A.D.

What do you think are some of the reasons Indian history could have been divided into these three periods?

This question yielded scores favoring the experimental group. It appears that these pupils were better able to conceptualize the divisions of the various time periods.

Question 3. The following sketch shows a profile (side view) of an Old Indian site. (Indian living area)

(I)	90% projectile points, 10% mortars, pestles
(II)	transitional 50%-50%
(III)	90% mortars, pestles, 10% projectile points

Three separate groups of people lived here as shown by layers I, II, and III. What can you say about the habits of each of these groups of people?

This question yielded comparable scores for both groups, but the control group outgained the experimental. Typical incorrect answers seemed to be conclusions that were not supported by the data. An example follows: "The high percentage of projectile points in level I shows that the people were warlike." This answer is not unreasonable, but in the context of the question it is incorrect.

Question 4. The items Indians buried with their dead give us clues about the ways in which they lived. For example, a recently excavated skeleton was found to have been buried with a mortar and pestle and an obsidian (volcanic type rock) knife. What conclusions can you make about this burial?

This question showed slightly higher scores by the experimental pupils. Wrong answers were typically incomplete rather than demonstrating a misunderstanding of the concepts involved in the question.

> Question 5. Make up an example of items which could be found in an Indian burial which could give clues about how the people lived. List both the items and the ways the people could have used them.

This question showed generally high scores for both groups and similar understanding although the experimental group pupils rated slightly higher.

> Question 6. Ishi (a native California Indian who was brought directly from the mountains into San Francisco) was able to adjust in many important ways to the white man's world. Why do you think he was able to do this?

The question showed considerably higher scores by the experimental group. These pupils appeared to have a superior understanding of the relative similarities between cultures that enabled Ishi to adjust than did the control pupils.

> Question 7. You find a bison bone in association with (together with) prehistoric Indians in Illinois. What conclusions can you make about this?

This question showed higher scores for experimental group pupils. The superior interpretation of artifacts in association seems clear-cut. Typically incorrect responses had unreasonable hypotheses formed on the basis of the data, e.g., "Indians killed the bison for revenge."

Question 8. You find numerous seashells in an inland Yokuts Indian site. How do you think the shells happened to be there?

This question showed higher scores for the experimental group pupils but the control group scored relatively high. Some wrong answers showed wild guessing, e.g., "The ocean may have covered there once."

Question 9. Ishi refused to eat certain foods, avoided mentioning the dead, and fasted before hunting. What conclusions can you make about these activities of Ishi?

This question showed higher scores for the experimental group. Correct answers showed positive assessment of religious and practical factors involving Ishi's fasting. Typical incorrect responses showed evidence of wild guessing; e.g., Ishi thought the dead might haunt him.

Question 10. Eskimos live in an extremely cold climate--they live in igloos; dress in heavy, warm skins; they eat seals, fish, etc. Would you say that the Eskimos are totally controlled by their environment? (The kind of place they live in and the climate) Why or why not?

This question showed equivalent low scores for both experimental and control groups. The question seems to be a poor one, despite pilot testing results, for the purposes of evaluating results of instruction. The investigator believes that different wording of the question would have yielded different results. The statement, "The Eskimos are totally controlled by their environment," seems to have clouded the issue for pupils at this level.

Question 11. Anthropologists have shown us that there are some kinds of physical differences between races, e.g., skin color, eye shape, etc. Are some races better than others? Why, or why not?

This question showed higher scores for the control group. The concept involved seems not to have been covered explicitly enough in instruction. Earlier learning may have been too firmly established in the area of races.

Question 12. Do you think the Indians had a good adjustment to their environment? That is, were they able to live well with their surroundings and satisfy their needs? Why, or why not? Give reasons for your ideas.

This question showed higher scores for the experimental group. Incorrect answers were incomplete.

In Section II, Part II, all five questions showed superior scores by the experimental group. (See attachment #1 for questions.) Each of these questions was designed to draw responses from the pupils in archaeological methods. All the questions provided novel contexts within which pupils were expected to apply previously learned concepts and principles. Pupils who actually performed the functions of archaeologists in the field proceeded with more certainty in the application of these methods.

t test results on Section I, Part II, and Section II, Parts I and II showed significant differences in favor of the experimental group.

Social Studies and the Prepared Test

As reported earlier, a positive correlation of .73 was found between the Stanford Achievement Test Social Studies subtest and the prepared anthropology pretest for both treatment groups. A similar comparison between the social studies scores and the posttest yielded a positive correlation of .45. These results would appear to indicate that the amount of knowledge about social studies influenced pupils' performance on the pretest but that its influence was reduced considerably in pupils' performance on the posttest, following instruction in anthropology. It seems to show that intervening instruction added something that was not there before, and that was helpful in obtaining higher scores on the prepared test for both treatment groups (see charts #4 and #5, pp. 74 and 75). This suggests that the control group as well as the experimental group was engaged in an effective instructional program.

The Posttest

The prepared posttest yielded significant differences favoring the experimental group on all individual subtests and the total of all subtests with the exception of Section I, Part I, which utilized the Kalahari Desert Bushman site map described earlier (see attachment #2). Part I is composed of five questions which specifically ask pupils to look at sketches of artifacts on the site map, examine the map closely, and determine what the artifact is. Pupils were asked to give their reasons as a part of each answer; for example, "Tell what you think artifact #16 is and give reasons for your answer." No readily discernible reasons indicate why no significant difference occurred on this subtest between experimental and control groups.

The statistical difference between experimental and control groups on the posttest total results and all but one of the subtests provides a strong case for the educational value of "discovery" type learning activities in elementary school. It should be noted as well, that the children in the experiment were nearing the end of sixth grade, and were considered to be capable of abstract thought without the necessity of concrete aids; in other words, they were entering Piaget's formal operations stage of development, although not necessarily in anthropology. A significant point is that children who were capable of learning effectively through verbal presentation methods appeared to learn more effectively through "discovery" activities. (See p. 68 for definition of "discovery.") Thus we have a successful "discovery" learning intervention that provides more implications than it would if carried out with elementary school children who were clearly in the concrete operations stage of mental development. It seems reasonable to conclude that "discovery" learning activities can produce superior results during the formal stage of mental development during which stage some authorities contend verbal learning is just as meaningful and much more time-saving. The investigator holds that "discovery" learning activities have established concepts and principles of anthropology in a more meaningful manner than instruction of a more verbal nature. This experiment provided an instance where elementary school children achieved superior results through "discovery" learning activities. Therefore, the investigator concludes that "discovery" learning activities in anthropology are worthwhile activities for upper elementary age children (sixth grade), who are considered to be functioning in the formal level of Piagetian cognitive operations. It is the investigator's opinion that these conclusions generally find themselves to be in opposition to those of Ausubel, who is a strong proponent of verbal learning. This is not to say, however, that the findings of this study and the above conclusions find themselves directly opposed to the views of Ausubel--this is essentially due to the qualifications Ausubel makes in his general attack on "discovery" learning. For example, Ausubel sees the desirability of "discovery" learning in the elementary grades when children are operating in the concrete operations stage, and also with adults who have reached the formal operations stage, but who are relatively unsophisticated in a discipline, and therefore might require "discovery" learning. (Ausubel, 1963, p. 151) It might very well be, considering the fact that children in the experimental sample were in the formal operations stage, but not necessarily in the formal stage in the discipline of anthropology, that Ausubel might consider this to be an exception to the general rule of opposition to "discovery" learning. It seems reasonable to assume that to the extent Ausubel recognizes the desirability of "discovery" learning, as in the instances described above, he weakens his own posture, which he has so systematically established, against those kinds of experiences.

In establishing his rationale for "discovery" learning Bruner (1966) stated the following: "Emphasis on discovery in learning has precisely the effect on the learner of leading him to be a constructionist, to organize what he is encountering in a manner designed to discover regularity and relatedness. Emphasis on discovery, indeed, helps the child to learn the varieties of problem solving, of transforming information for better use, helps him to learn how to go about the very task of learning." (p. 87) He continued, "The degree that one is able to approach learning as a task of discovering something rather than learning about it, to that degree there will be a tendency for the child to work with the autonomy of self-reward or, more properly be rewarded by discovery itself." (p. 88)

The results of the IVP favoring the experimental group seem consistent with Bruner's statements.

Conclusions Upheld

The investigator concludes that the preceding hypotheses have been upheld in the Inland Valley Elementary School Archaeology Project. In the discovery tasks (see Discovery Operational, p. 68), the child participating in the "dig" was in a more active learning situation when compared with those pupils who did not participate in the "dig." In other words, the child at the "dig" was more of a constructionist--more of an organizer of information--more active in the task of learning, and apparently more highly motivated.

The discovery learning activity itself produced significant differences in favor of children in the experimental group on the prepared test which was specifically devised to test anthropological understandings. (See Instrumentation, p. 51.) The results of this experiment give support to the overall position that Bruner holds regarding the "discovery" learning process.

It was stated that the intention of the experiment was to place students in the position of being able to "discover" by means of the archaeological "dig" in the discipline of anthropology. The investigator concludes that the stated purpose of this experiment has been carried out within the frame of reference described above, and with results favoring the experimental group. (See Chapter IV.)

Implications of Findings

In light of the findings the investigator concludes that "discovery" type learning activities have been successful in the discipline of anthropology and would suggest that other disciplines could provide equal opportunity for these kinds of learning experiences. An important consideration in this respect is that the "discovery" lessons themselves should be taught within the framework of a discipline, as distinguished from "discovery" learning activities organized around a scattered collection of largely unrelated facts. This point is considered important even though pupils in both IVP treatment groups learned a structure within the discipline of anthropology. This suggestion regarding "discovery" is an attempt to deny "discovery" learning as an end in itself. "Discovery" learning is seen as a vehicle for bringing students to an understanding of the structure of a discipline.

"Discovery" learning activities are time-consuming. The "discovery" activities of the experiment took approximately four times as long as the more verbal kind of instruction of the control group. It is therefore recommended that "discovery" learning units be selected carefully and with the overall needs of the pupils in mind, lest we become overly enthusiastic and deny ourselves the advantages of verbal learning, e.g., efficiency, as described by Ausubel. The sum total of those known factors which make up a child's readiness for specific learning activities should serve as guidelines, especially cognitive developmental levels. It would seem wasteful, for example, to prepare a curriculum entirely of "discovery" activities for pupils functioning in the Piagetian formal operations stage, even though the need for "discovery" activities seems firmly established for earlier levels. The cumulative effect would seem to restrict learning to a minuscule portion of that which is possible through verbal pedagogical strategies. It would appear that the child functioning in the formal operations stage should have a curriculum geared to take meaningful advantage of his ability to correlate abstractions. This assertion is made even though the Inland Valley Elementary School Archaeology Project has shown the superiority of "discovery" learning in this experiment. The IVP has shown that "discovery" learning has a place in the curriculum--but that place must be evaluated realistically in terms of the child himself.

On the basis of the experience with the IVP, there are indications that such variables as pupil motivation, the experience of real success, and meaningful learning experiences in a discipline will provide a springboard to success in academic activities in general; that once the barrier between superficial and meaningful learning experience is broken, wide access to successful experience in all academic areas will become possible. Only some modest indications have been provided in this direction in the present study.

To recapitulate the significance of the results of this experiment we refer to the psychological rationale which was developed in Chapter II. Presentational learning as distinguished from "discovery" learning provides a focus for the IVP. The difference tested, however, does not test presentational learning vs. "discovery" learning in the strictest sense. The experiment showed differences between those children who actually participated in an excavation of an archaeological site and those children who did not. In other words, the experimental group participated in "discovery" activities in the field with a teacher who was necessarily unaware of the ultimate outcomes, whereas the control group acquired the same understandings in a more verbal manner, taught by a teacher who was aware of the ultimate results to be obtained by the instruction.

It will be recalled that the same teacher taught the experimental and control groups. The teacher taught the control group in a verbal manner, but she did not alter her pedagogical strategies to eliminate all aspects of "discovery" learning as it might occur in the instruction given to the control group in the classroom. Thus the "presentational" vs. "discovery" issue becomes one of degree in the IVP.

Limitations of the Study

The Sample

The sample of experimental and control group pupils was drawn from a relatively high socioeconomic pupil population. This factor necessarily limits the generalization of this study to similar populations--although a relatively large number of pupils may fall into a similar category. This limitation, however, in no way detracts from the possibility that "discovery" activities are highly worthwhile in other student populations. This is a distinct possibility, and one which needs further investigation.

The Teacher of Experimental and Control Groups

Although the teacher of the experimental group gave instruction to both treatment groups, her own class (homeroom) was the experimental group. Every effort was made to prevent any learning advantage for experimental pupils, but the outcome would have been more assured had the teacher been assigned the control group for a homeroom class.

Pupils

Pupils from both treatment groups were told that they were to participate in an archaeological "dig." This was done to control for the "Hawthorne" effect; however, no attempt was made to control out-of-class activities, such as recess periods, to prevent the possibility of contamination.

Testing

A one-test criterion was used for this experiment. No testing was carried out to determine retention, nor was any device prepared to evaluate transfer of learning.

Suggestions for Further Study

In view of the apparent learning advantages of the experimental group in the IVP wherein the experimental group participated in an actual archaeological "eig" and was compared to a control group which received instruction of a more verbal type in the classroom, it seems appropriate to suggest future studies based upon the results of this experiment.

A follow-up study is indicated which would compare experimental and control groups in an experimental situation in which the control group and the experimental group would receive instruction in anthropology (as in IVP) together up to the point of the "dig." At this juncture the experimental group would participate in the excavation of a simulated "dig" at a locale convenient to the elementary school. The archaeological materials could be "planted" by an archaeologist. The control group could then be taught the same lessons in a verbally oriented manner; and the results (test scores) between the two treatment groups compared. This same experiment could also be performed with "discovery" lessons using materials already excavated. The following sketch delineates some of the possible studies which could be carried

No claim has been made in this study that anthropology is the one discipline which could or should become the focal point of elementary school instruction or a natural bridge or synthesizer between the physical and natural sciences, although the relatedness of anthropology to other disciplines does seem to afford a special advantage. It is suggested, however, that on the basis of the results of the IVP, similar studies could be effectively implemented in other disciplines. The key propositions involve making a curriculum which is built upon the structure of a discipline in the light of the nature of the developmental characteristics of children. Such an undertaking in any discipline is recommended as being worthwhile.

Conclusions

It has been the intention of this study to provide a situation in which elementary school children could function in the discipline of anthropology. In the experiment children operated in the manner of archaeologists in the field and to all intents and purposes showed significant benefit from the opportunity to do so.

The experiment comes at a time in the history of American curriculum development that appears conducive to change. Increasing insights into the development of the human mind have opened avenues of curriculum construction which seem to be more solidly based psychologically than ever before. Recent emphasis on the disciplines and increasing participation by scholars in curriculum work have set the stage for change. It is the investigator's belief that this study is in tune with current trends in curriculum and it is his hope that the study will provide some impetus to the establishment of a sound educational experience for elementary school children which takes into account the developmental factors of children.

The importance of the study rests in the fact that participation by sixth grade children in anthropology--in the manner of archaeologists--did make a significant difference in their performance in comparison with a control group. It is believed that this difference is important within the previously defined limits. It is also believed that these results call for more experimentation of this kind in anthropology and in other disciplines. It is not maintained or even suggested that "discovery" learning should replace verbal learning, nor that verbal learning is not meaningful to elementary school children; and, most emphatically, it is not claimed that most or even a major portion of sixth grade curriculum should be composed of "discovery" activities. The results of the experiment have helped establish "discovery" learning as a meaningful part of elementary curriculum that deserves serious consideration and experimentation. It has been said that "discovery" learning has a place in elementary curriculum and it has been suggested that these kinds of activities may produce benefits in elementary pupils beyond the scope of the controls and measurements of this experiment. For example, it has been suggested to the reader that successful experiences in anthropology can possibly transfer to other (possibly many other) academic areas. No proof has been offered, nor has an attempt been made to establish a cause/effect relationship; however, the investigator believes that this is a distinct possibility.

To recapitulate, the central purpose of the study was to provide an opportunity for sixth grade children to participate in a "discovery" learning experience in the field of anthropology, and to compare this group (by testing) with a control group which obtained the same information in a more verbal manner in the classroom. These activities were carried out, and results of the testing showed significant gains by the experimental group over the control group.

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APPENDIX

ATTACHMENT #1

ANTHROPOLOGY TEST

SECTION I

The map you have been given represents the site (abandoned living area) of a primitive group of people. We can make certain guesses about their culture (the way they lived), by studying this map. In addition to the site map you will need to have the following information.

1. This is a surface site. Everything is found on the surface of the ground. No digging has been carried out.
2. The site is located on the Kalahari Desert--there are six to ten inches of rain each year, not enough to support agriculture, but adequate for maintaining human life by other means.
3. Mongongo nut trees grow in the Kalahari Desert.
4. The Kalahari has temporary sources of water that seasonally dry up.
5. The Kalahari has permanent water sources (springs).

Section I, Part I

An important part of learning about other cultures involves making good guesses about the tools, implements, and other things that the people used. (These things are called artifacts.) The following questions will give you the opportunity to make guesses about artifacts. Some items will seem easy to guess and others more difficult. Study your site map carefully before writing your answers. As you look at the artifacts and study the map, think carefully about what the items were possibly used for, the particular way in which they might have been used, and by whom. When artifacts were used is also sometimes important--in other words, some tools were used only during certain times of the year.

THINK ABOUT THE REAL MEANING OF THE ARTIFACTS TO THE PEOPLE WHO USED THEM.

1. Number 6 printed at the top of your site map states: Curved stick, pointed end. Tell what you think this is and why. (Give some reasons for your idea.)

2. Tell what you think number 9 is and why. (Give some reasons for your idea.)

3. Tell what you think number 16 is and why. (Give some reasons for your idea.)

4. Tell what you think number 20 is and why. (Give some reasons for your idea.)

5. Tell what you think number 2 is and why. (Give some reasons for your idea.)

Section I, Part II

Using this site map to help you, answer as many of the following questions as you can.

1. What must all people have in order to survive?

2. How old do you think the site is?

3. Would you call this a hunting, gathering, or an agricultural society? Why do you think so?

4. What do you think the people ate? Why do you think so?

5. How do you think they obtained their food?

6. What do you think the people manufactured? (goods, tools, etc.)

7. How many people do you think lived in the site? How do you know?

8. Do you think these people had fire? What reasons do you have for your idea?

9. If these people had fire, how do you think they obtained it? What reasons do you have for your idea?

10. How do you think food was prepared? What reasons do you have for thinking so?

11. Do you think there is any evidence of religious or recreational ceremonies? What evidence do you see?

12. In what kind of dwellings do you think the people lived?

13. Do you think the people had domestic animals? What are your reasons for thinking this?

14. Do you think there was a chief or tribal leader of the group? What are your reasons for your ideas?

Section II, Part I

Answer the following statements or questions.

1. How do you think California Indians got their food? What reasons do you have for thinking this?

2. California Indians were divided into groups called Horizons.

   Early Horizon Indians lived from 4000 to 2000 B.C.
   Middle Horizon Indians lived from 1500 B.C. to 700 A.D.
   Late Horizon Indians lived from 700 A.D. to 1600 A.D.

   What do you think are some of the reasons Indian history could have been divided into these three periods?

3. The following sketch shows a profile (side view) of an old Indian site. (Indian living area)

(I)	90% projectile points, 10% mortars, pestles
(II)	transitional 50%-50%
(III)	90% mortars, pestles, 10% projectile points

   Three separate groups of people lived here as shown by layers I, II, and III. What can you say about the habits of each of these groups of people?

4. The items Indians buried with their dead give us clues about the ways in which they lived. For example, a recently excavated skeleton was found to have been buried with a mortar and pestle and an obsidian (volcanic type rock) knife. What conclusions can you make about this burial?

5. Make up an example of items which could be found in an Indian burial which could give clues about how the people lived. List both the items and the ways the people could have used them.

6. Ishi (a native California Indian who was brought directly from the mountains into San Francisco) was able to adjust in many important ways to the white man's world. Why do you think he was able to do this?

7. You find a bison bone in association with (together with) prehistoric Indians in Illinois. What conclusion can you make about this?

8. You find numerous seashells in an inland Yokuts Indian site. How do you think the shells happened to be there?

9. Ishi refused to eat certain foods, avoided mentioning the dead, and fasted before hunting. What conclusion can you make about these activities of Ishi?

10. Eskimos live in an extremely cold climate--they live in igloos; dress in heavy, warm skins; they eat seals, fish, etc. Would you say that the Eskimos are totally controlled by their environment? (The kind of place they live in and the climate.) Why, or why not?

11. Anthropologists have shown us that there are some kinds of physical difference between races, e.g., skin color, eye shape, etc. Are some races better than others? Why, or why not?

12. Do you think the Indians had a good adjustment to their environment? That is, were they able to live well with their surroundings and satisfy their needs? Why, or why not? Give reasons for your ideas.

Section II, Part II

Essay.

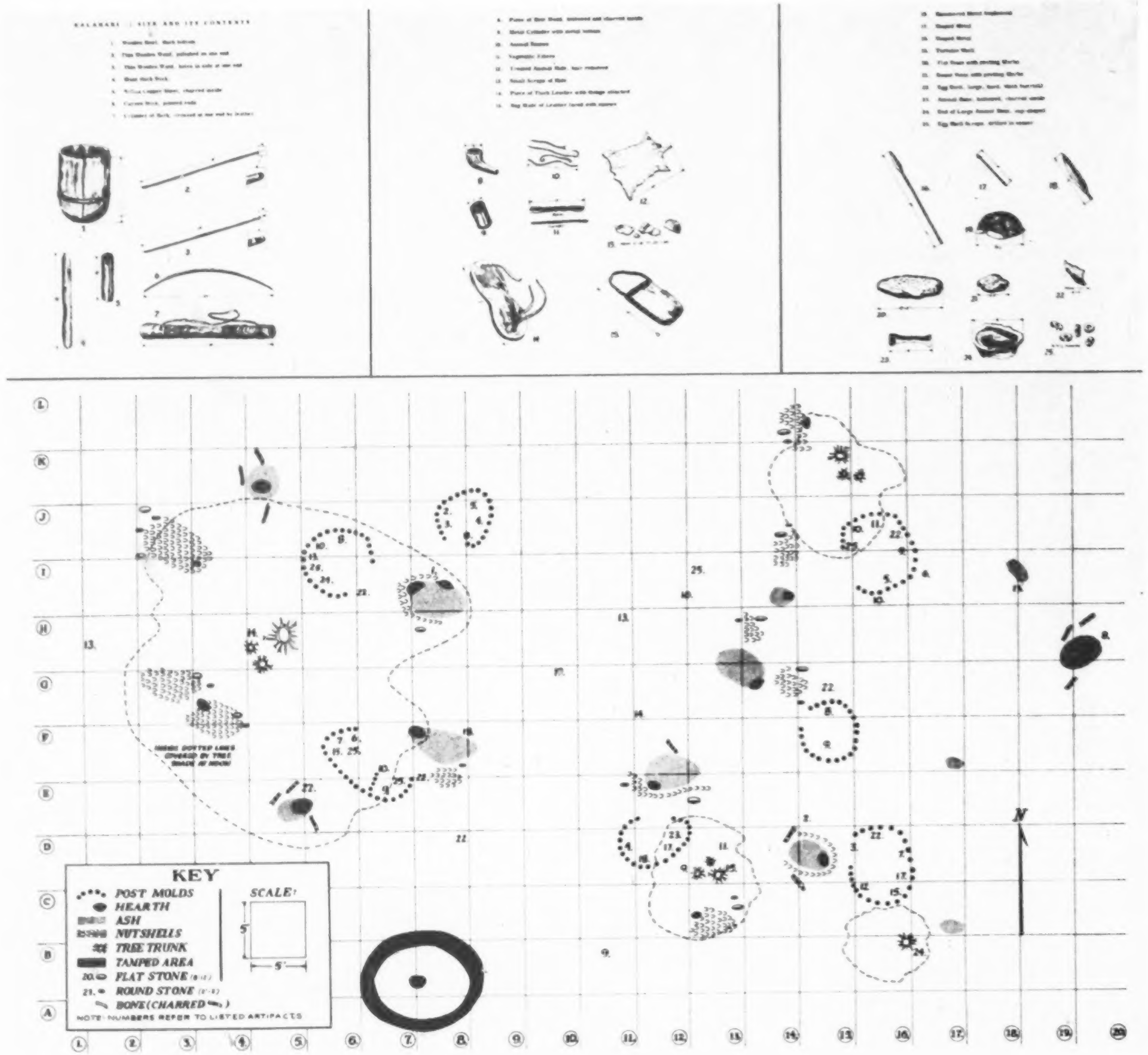
1. An archaeologist announces the excavation of an early Horizon site. What evidence must he have gathered to prove that this is an early Horizon site?

2. Farmers refer to the South 40 or the North 40 when talking about parts of their farms. Give as complete an explanation of this as you can.

3. You have been selected to determine whether or not the excavation of a suspected army fort site is worthwhile. How would you proceed? (The place where the fort might have been has no buildings or other surface signs of habitation.)

4. Finding that you wish to excavate the entire site (question 3), describe in detail the method of excavation you will use.

5. In question 4 above, one of your findings is a skeleton of unknown origin. How would you carry out the excavation of the skeleton? Give step-by-step procedures for removing it from the ground.


KALAHARI — SITE AND ITS CONTENTS
KEY
POST MOLDS
HEARTH
ASH
NUTSHELLS
TREE TRUNK
TAMPED AREA
20. FLAT STONE
21. ROUND STONE
BONE (CHARRED)
NOTE: NUMBERS REFER TO LISTED ARTIFACTS
SCALE:
5'
5'
INSIDE DOTTED LINES COVERED BY TREE SHADE AT NOON
N
A
B
C
D
E
F
G
H
I
J
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ATTACHMENT #3

TEST STANDARDS

I.I.

Read Test Directions - Kalahari Site Report

1. Number 6 printed at the top of your site map states: Curved stick, pointed end. Tell what you think this is and why. (Give some reasons for your idea.)

   ANSWER: A bow.
   WHY: Shape. Other acceptable answers for why:
   #7 looks like a quiver.
   #16, #17, #18 could be projectile points associated with bow.

2. Tell what you think number 9 is and why. (Give some reasons for your idea.)

   ANSWER: A can, or other answer containing information that shows knowledge that it is a can, e.g., A metal container used by primitive people for water, food, etc.
   WHY: Shape or metal container.

3. Tell what you think number 16 is and why. (Give some reasons for your idea.)

   ANSWER: A spear.
   WHY: Shape or other characteristics of this spear, e.g., shaped metal point.

4. Tell what you think number 20 is and why. (Give some reasons for your idea.)

   ANSWER: A stone used for cracking nuts or other purposes that show functional use, e.g., a pestle or hammerstone.
   WHY: Pecking marks, chipped places, or other answer showing this meaning. Also location near shells and fire.

5. Tell what you think number 2 is and why. (Give some reasons for your idea.)

ANSWER: A fire-making tool.
WHY: In association with #3. Or, polished end. Or, in association with fire.

I.II.

1. What must all people have in order to survive?

ANSWER: Food, water, air.
This question allows score of 4 points for any general answer.

2. How old do you think the site is?

ANSWER: Young, recently occupied, within 50 years. Late Horizon. Because the articles are on the surface and because of the presence of metal.

3. Would you call this a hunting, gathering, or an agricultural society? Why do you think so?

ANSWER: Hunting and gathering.
WHY: Presence of nut shells, tortoise shell, eggshells, animal bones, leather. No evidence of agriculture.

4. What do you think the people ate? Why do you think so?

ANSWER: Nuts, tortoise, animal meat, eggs.
WHY: Presence of shells, leather, bones.

5. How do you think they obtained their food?

ANSWER: Hunt and gather.
WHY: Spears, projectile points, weapons, bones, nut shells, eggshells, tortoise shells.

6. What do you think the people manufactured? (goods, tools, etc.)

ANSWER: Clothes, shoes, weapons, baskets, quivers.
(One point each for total of 4 points.)

7. How many people do you think lived in the site? How do you know?

ANSWER: 15 to 25.
WHY: Number of huts.

8. Do you think these people had fire? What reasons do you have for your idea?

ANSWER: Yes.
WHY: Ashes, hearths, charred bone.

9. If these people had fire, how do you think they obtained it? What reasons do you have for your idea?

ANSWER: Friction of wood on wood.
WHY: Fire-making tools #2 and #3.

10. How do you think food was prepared? What reasons do you have for thinking so?

ANSWER: Nuts cracked, meat butchered, cooked over fire.
WHY: Hearths, pecked rock, charred bones.

11. Do you think there is any evidence of religious or recreational ceremonies? What evidence do you see?

ANSWER: Yes.
WHY: Tamped area around hearth (lower left).
Sucking tube.

12. In what kind of dwelling do you think the people lived?

ANSWER: Huts (acceptable for 4 points).
WHY: Post molds were support for a round type of hut.

13. Do you think the people had domestic animals? What are your reasons for thinking this?

ANSWER: No.
WHY: No evidence.

14. Do you think there was a chief or tribal leader of the group? What are your reasons for your ideas?

ANSWER: No.
WHY: No evidence.

EACH ANSWER RECEIVES TWO POINTS AND EACH REASON RECEIVES TWO POINTS, A TOTAL OF FOUR POINTS PER QUESTION.

II.II.

1. How do you think California Indians got their food? What reasons do you have for thinking this?

   ANSWER: Hunted and gathered.
   WHY: Artifacts show this. Reading.

2. California Indians were divided into groups called Horizons.

   Early Horizon Indians lived from 4000 to 2000 B.C.
   Middle Horizon Indians lived from 1500 B.C. to 700 A.D.
   Late Horizon Indians lived from 700 A.D. to 1600 A.D.

   What do you think are some of the reasons Indian history could have been divided into these three periods?

   ANSWER: Changes within the cultures of the Indian tribes (artifacts, habits, etc.) define definite periods of time.

3. The following sketch shows a profile (side view) of an old Indian site. (Indian living area.)

(I) 90% projectile points, 10% mortars, pestles
(II) transitional 50%-50%
(III) 90% mortars, pestles, 10% projectile points

Three separate groups of people lived here as shown by layers I, II, III. What can you say about the habits of each of these groups of people?

ANSWER: I. Hunters
II. Hunters and gatherers
III. Gatherers. Group III were the oldest (most primitive).

4. The items Indians buried with their dead give us clues about the ways in which they lived. For example, a recently excavated skeleton was found to have been buried with a mortar and pestle and an obsidian (volcanic type rock) knife. What conclusions can you make about this burial?

   ANSWER: Customs of the Indians to bury one's belongings with him for later life. A woman, a good cook.

5. Make up an example of items which could be found in an Indian burial which could give clues about how the people lived. List both the items and the ways the people could have used them.

   ANSWER: Mortar and pestle - gatherers.
   Projectile points - hunters.
   Red ocher, quartz crystals, charmstones, etc. - religion.
   Clay pipe - man.
   Sucking tube - Shaman.
   Basketry - women.

6. Ishi (a native California Indian who was brought directly from the mountains into San Francisco) was able to adjust in many important ways to the white man's world. Why do you think he was able to do this?

   ANSWER: Ishi was an extremely intelligent man from a well developed tribe. He knew there was no turning back to his old ways, when his tribe was gone. He received much help from the white men.

7. You find a bison bone in association with (together with) prehistoric Indians in Illinois. What conclusions can you make about this?

   ANSWER: Bison lived at the time of these Indians. It was a religious custom. Bison used for food and possibly clothing.

8. You find numerous seashells in an inland Yokuts Indian site. How do you think the shells happened to be there?

   ANSWER: Trade or bartering. Periodic visitations to the coast to hunt and fish.

9. Ishi refused to eat certain foods, avoided mentioning the dead, and fasted before hunting. What conclusion can you make about these activities of Ishi?

   ANSWER: These were customs of his tribe. Speaking of the dead was bad luck. He fasted to cut down on body odor before he hunted.

10. Eskimos live in an extremely cold climate--they live in igloos; dress in heavy, warm skins; they eat seals, fish, etc. Would you say that the Eskimos are totally controlled by their environment? (The kind of place they live in and the climate.) Why, or why not?

    ANSWER: No.

WHY: The Eskimos could leave the area.
Man has many choices above and beyond the dictates of his environment.

11. Anthropologists have shown us that there are some kinds of physical difference between races, e.g., skin color, eye shape, etc. Are some races better than others? Why, or why not?

ANSWER: No.
WHY: Although the races appear to be different and some people are more intelligent than others, people are basically the same.

12. Do you think the Indians had a good adjustment to their environment? That is, were they able to live well with their surroundings and satisfy their needs? Why, or why not? Give reasons for your ideas.

ANSWER: Yes.
WHY: Although Indian culture was radically different from our own in many respects it showed a compatible relationship between the different tribes and their particular surroundings.